

Fig 1

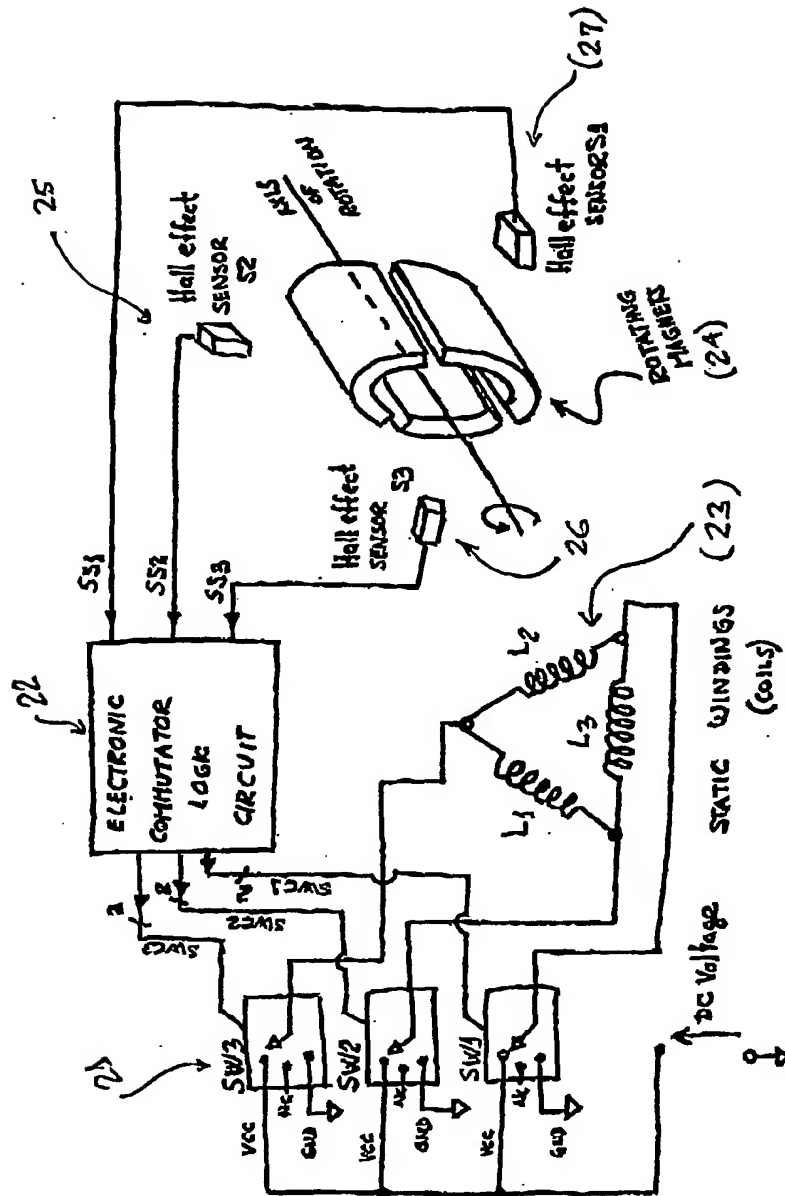


Fig 2

Permanent magnet brushless DC motor

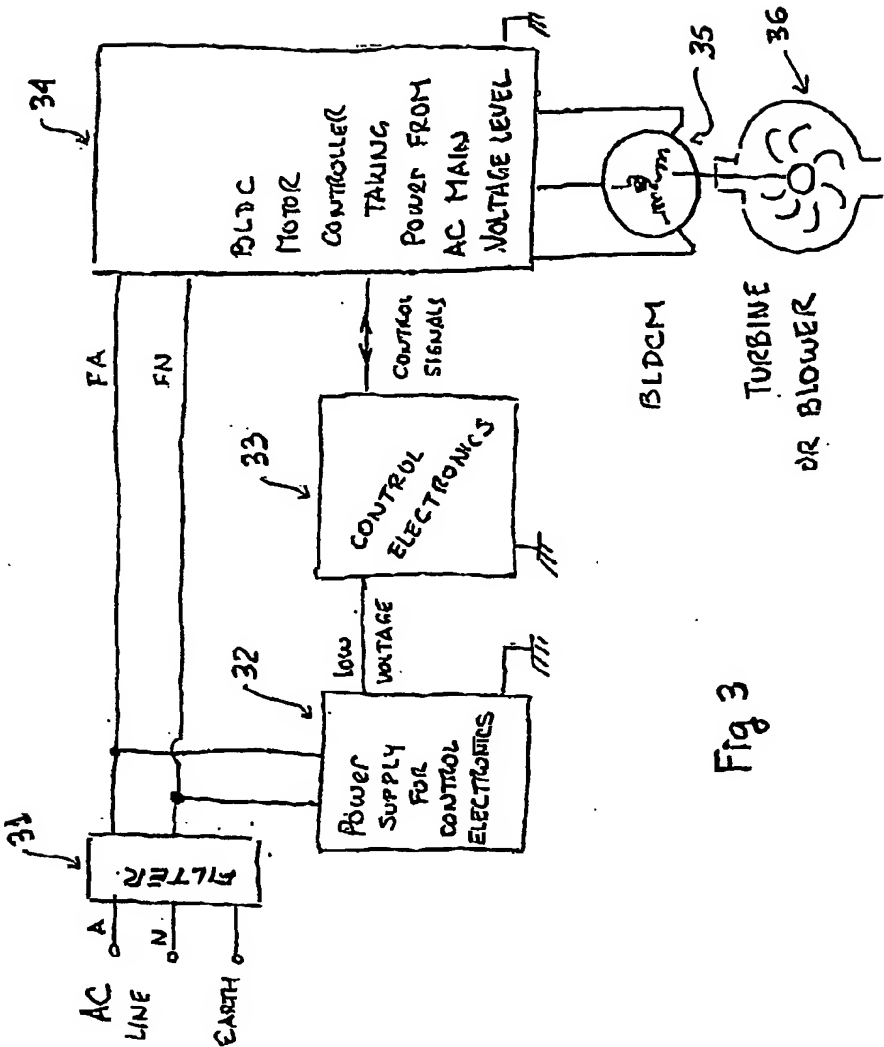


Fig 3

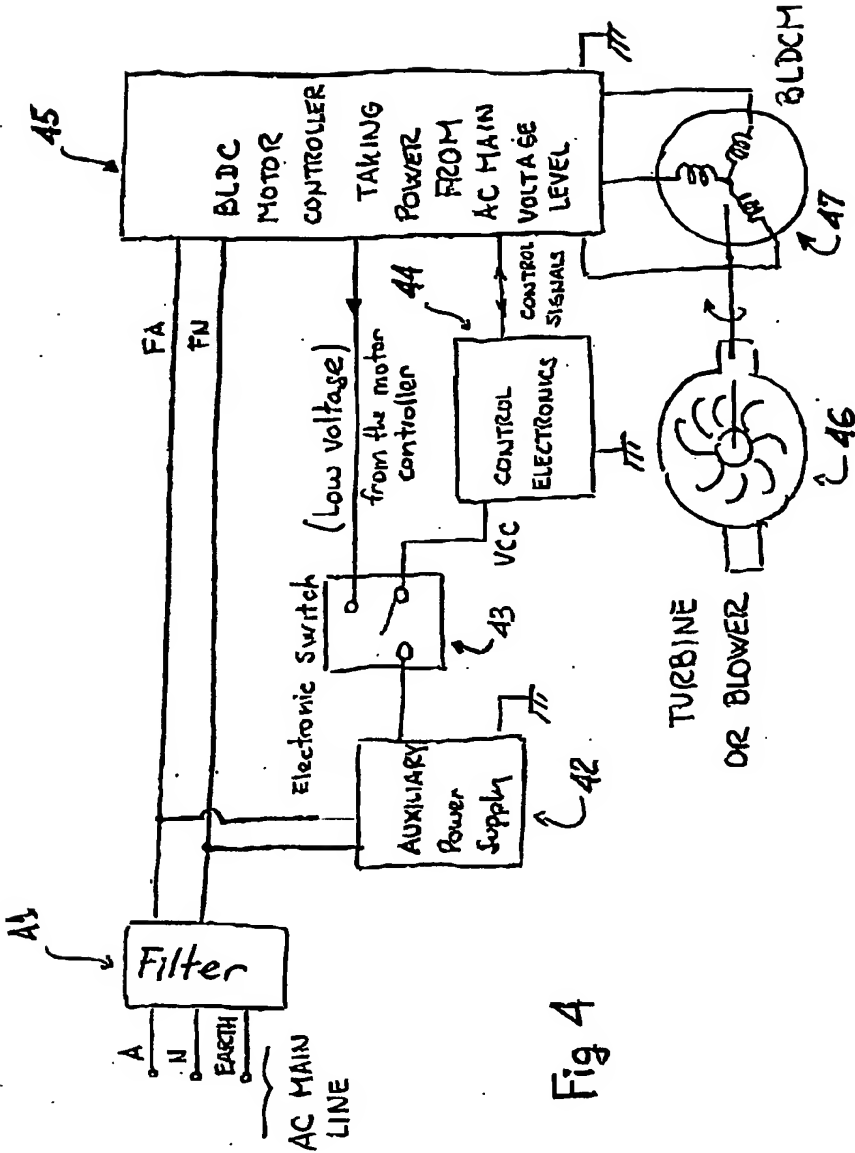
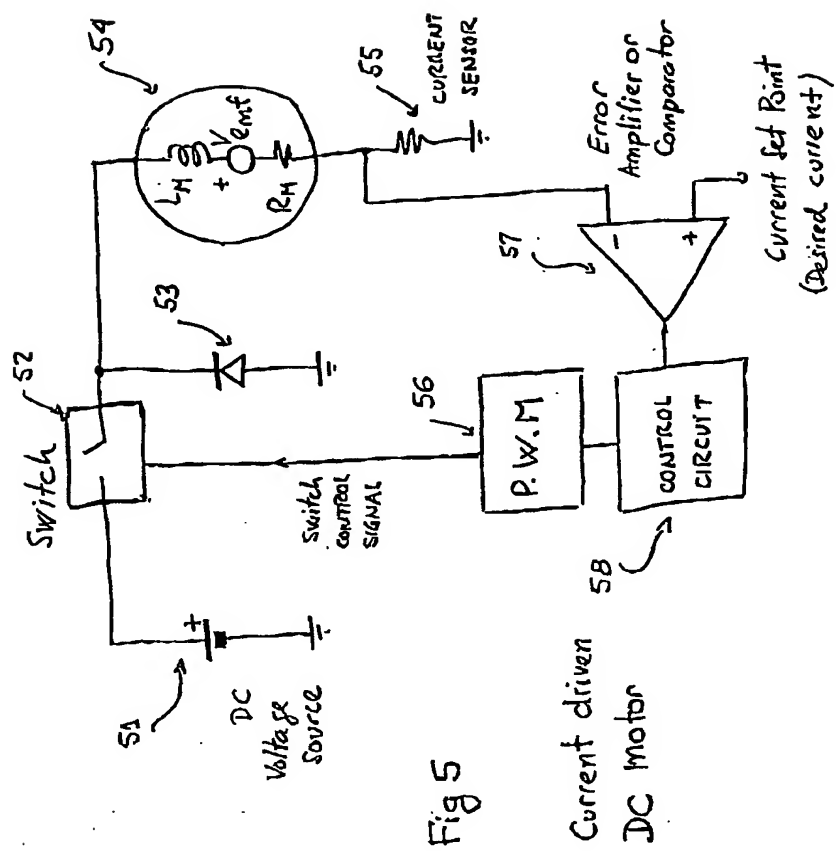
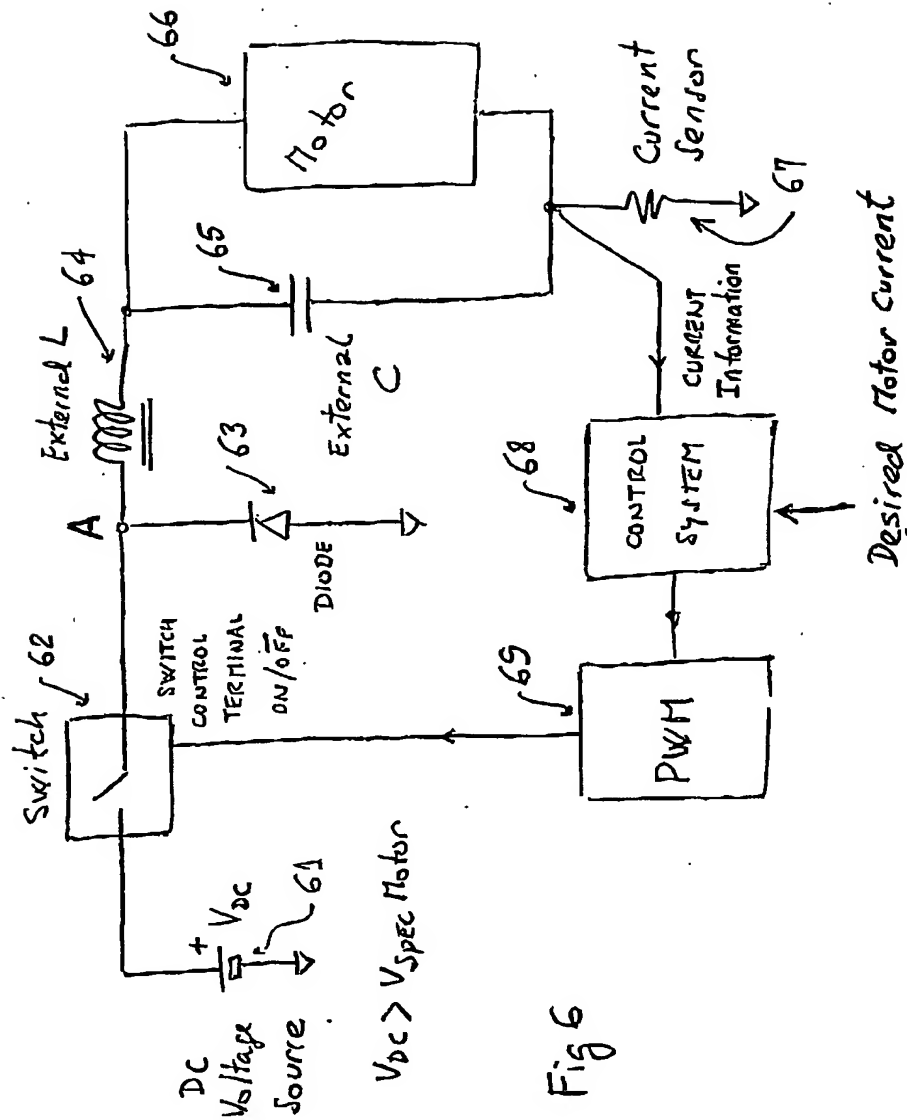
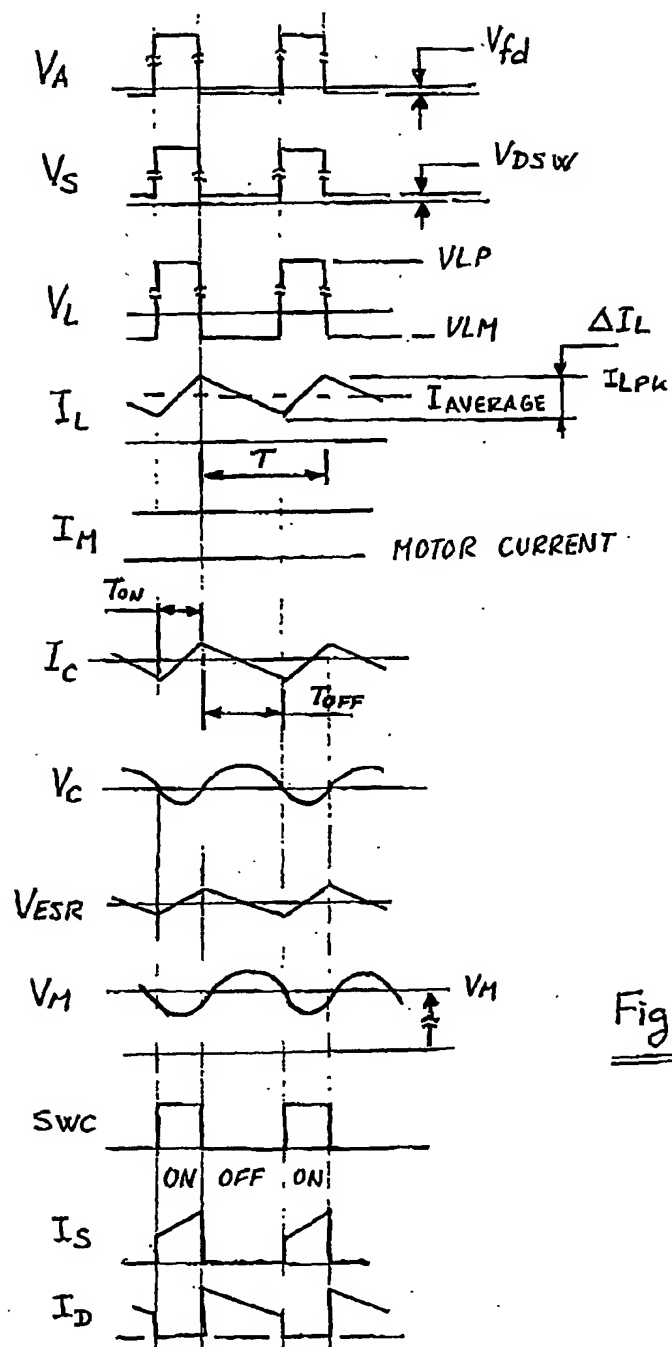


Fig 4





Fig. 6A

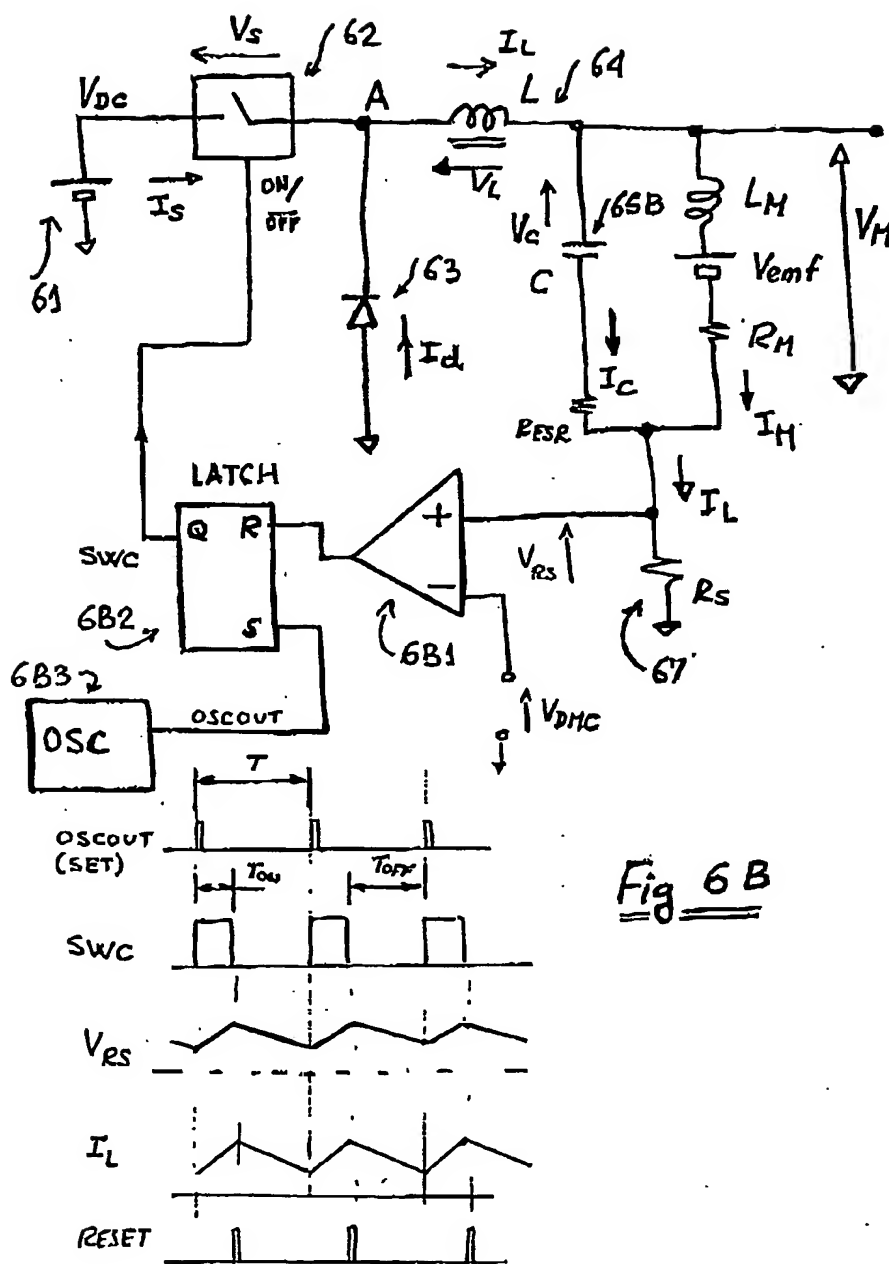


Fig 6B



Fig 6C-1

- 1)  $V_S = V_{DC} - V_A$
- 2)  $V_L = V_A - V_M$
- 3)  $V_M \cong I_M R_M + V_{emf}$
- 4)  $V_{emf} = k_v \omega_M$
- 5)  $I_S = I_L$
- 6)  $I_L = I_C + I_M$
- 7)  $I_L = V_{RS} / R_S$
- 8)  $V_M = V_C + I_C R_{ESR}$
- 9)  $T = T_{ON} + T_{OFF}$
- 10)  $I_L = I_{AVERAGE} + I_L(t)$
- 11)  $I_{L PK} = I_{AVERAGE} + \Delta I_L / 2$
- 12)  $I_{L MIN} = I_{AVERAGE} - \Delta I_L / 2$
- 13)  $I_M = I_{AVERAGE}$
- 14)  $I_C = I_L(t)$
- 15)  $I_L(t) = \frac{1}{L} \int V_L(t) dt$
- 16)  $I_L = \frac{V_L}{L} t = \frac{V_A - V_M}{L} t$
- 17)  $I_L = \frac{V_{DC} - V_S - V_M}{L} t$

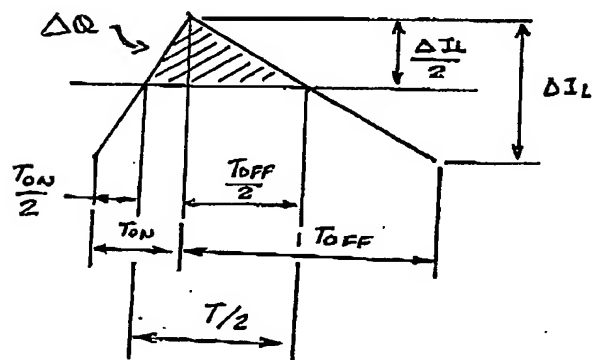
$$18) \quad \Delta I_L = \frac{V_{DC} - V_S - V_{TH}}{L} T_{ON} \quad \text{Fig 6C-2}$$

$$19) \quad |\Delta I_L| = \frac{V_{TH} + V_{fdl}}{L} T_{OFF}$$

$$20) \quad \frac{V_{DC} - V_S - V_{TH}}{L} T_{ON} = \frac{V_{TH} + V_{fdl}}{L} T_{OFF}$$

$$21) \quad (V_{DC} - V_{TH}) T_{ON} \cong V_{TH} T_{OFF}$$

$$22) \quad V_{TH} \cong V_{DC} \frac{T_{ON}}{T_{ON} + T_{OFF}} = V_{DC} \frac{T_{ON}}{T}$$

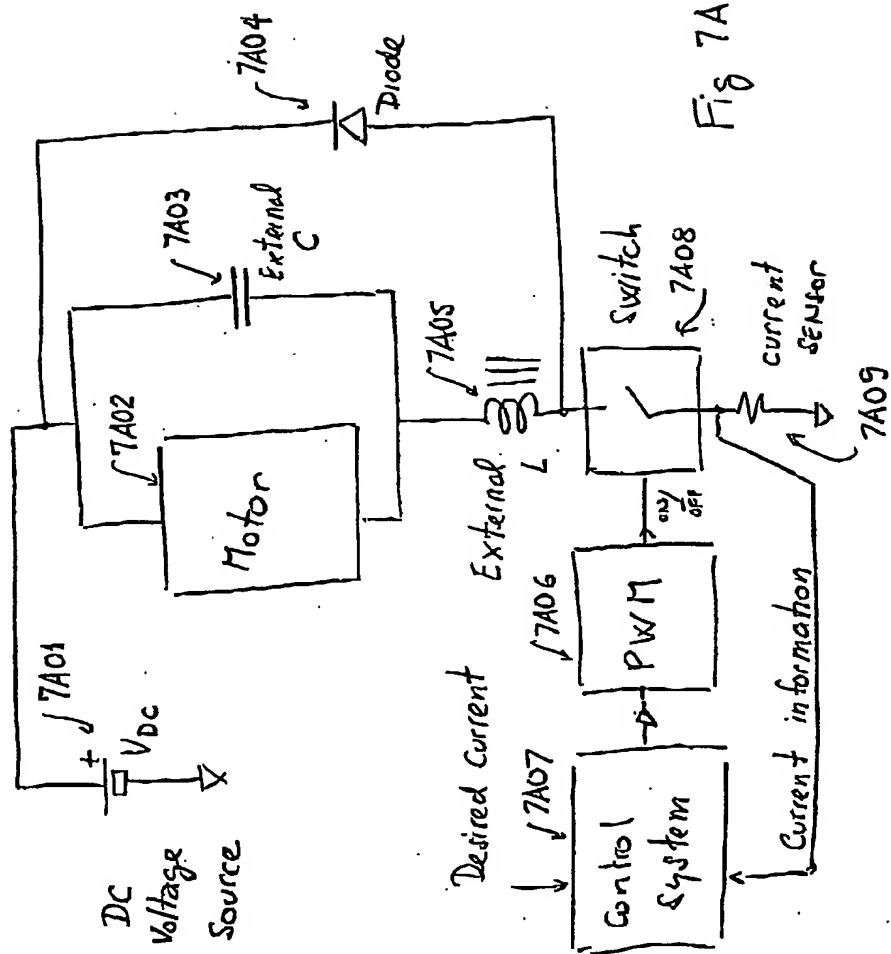


$$23) \quad \Delta Q = \frac{1}{2} \cdot \frac{T}{2} \cdot \frac{\Delta I_L}{2}$$

$$24) \quad \Delta V_C = \frac{\Delta Q}{C} = \frac{\Delta I_L}{f 8 C}$$

$$25) \quad \Delta V_C = \Delta V_{Cc} + \Delta I_L R_{ESR}$$

$$26) \quad \Delta V_C \ll V_{TH}$$



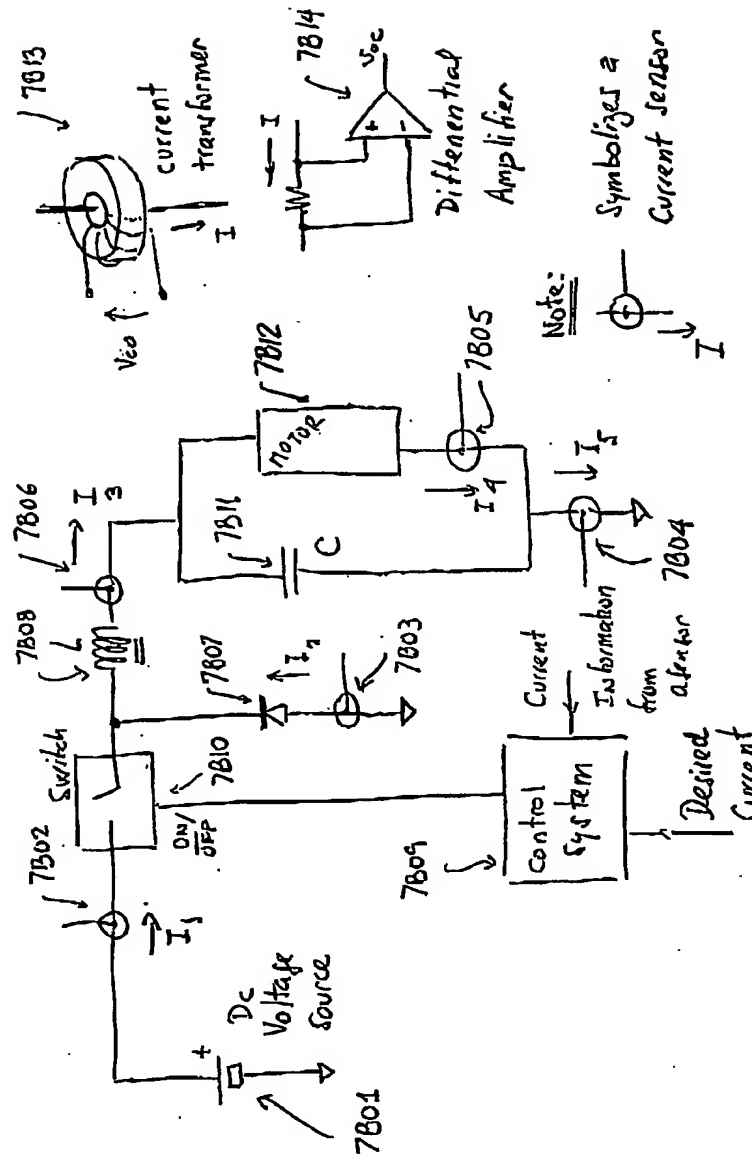


Fig 7B  
Positions of current sensors

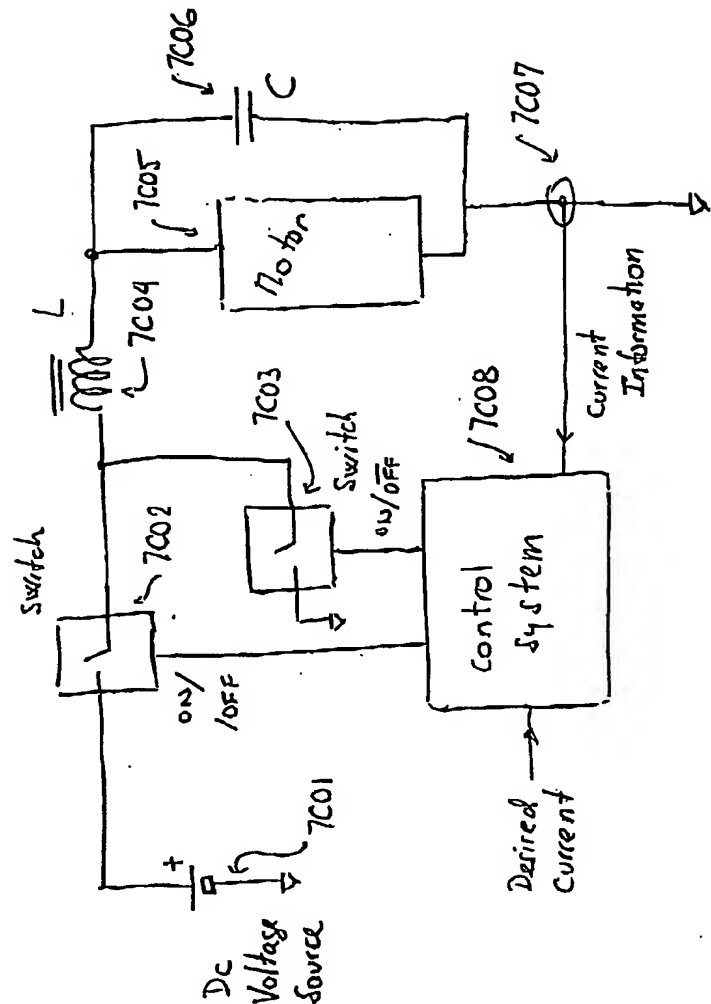


Fig 7C  
With Synchronous rectification

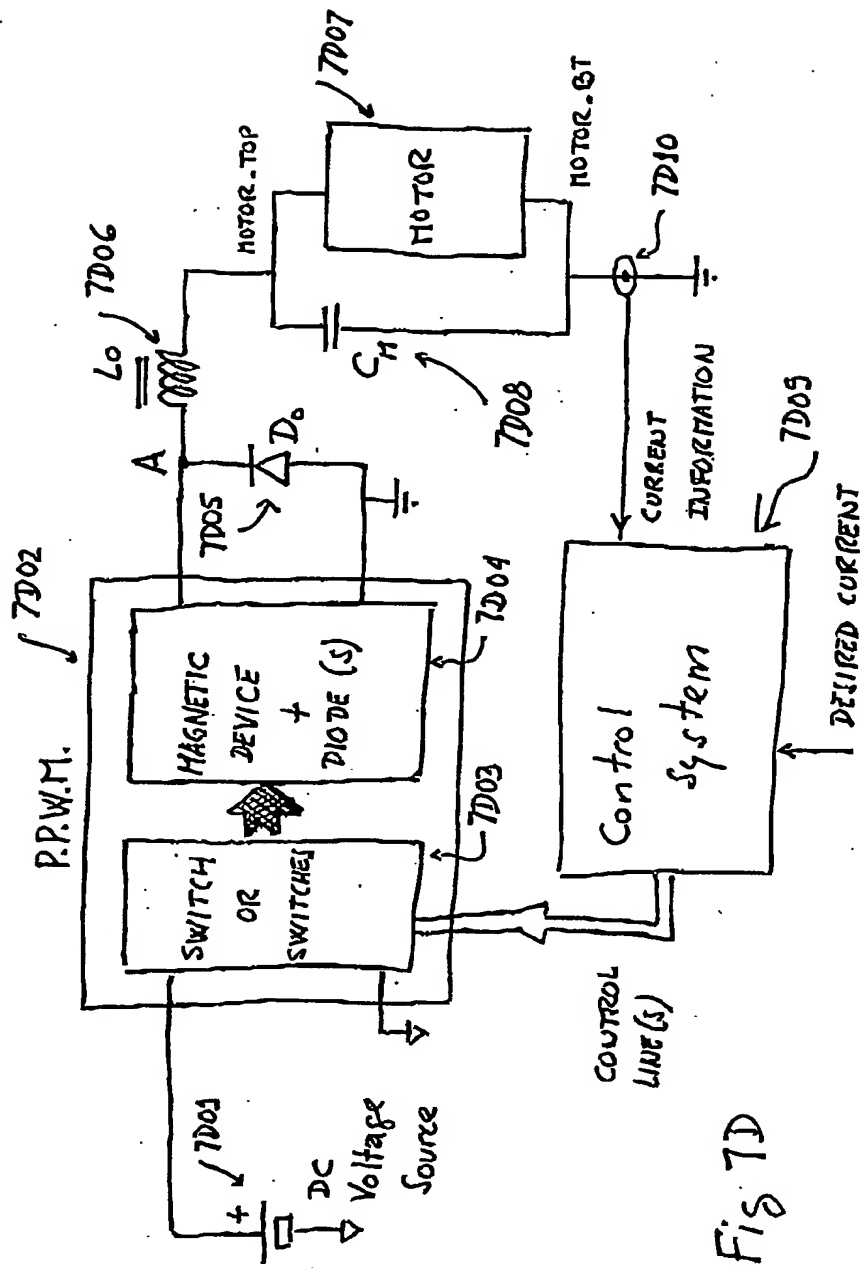
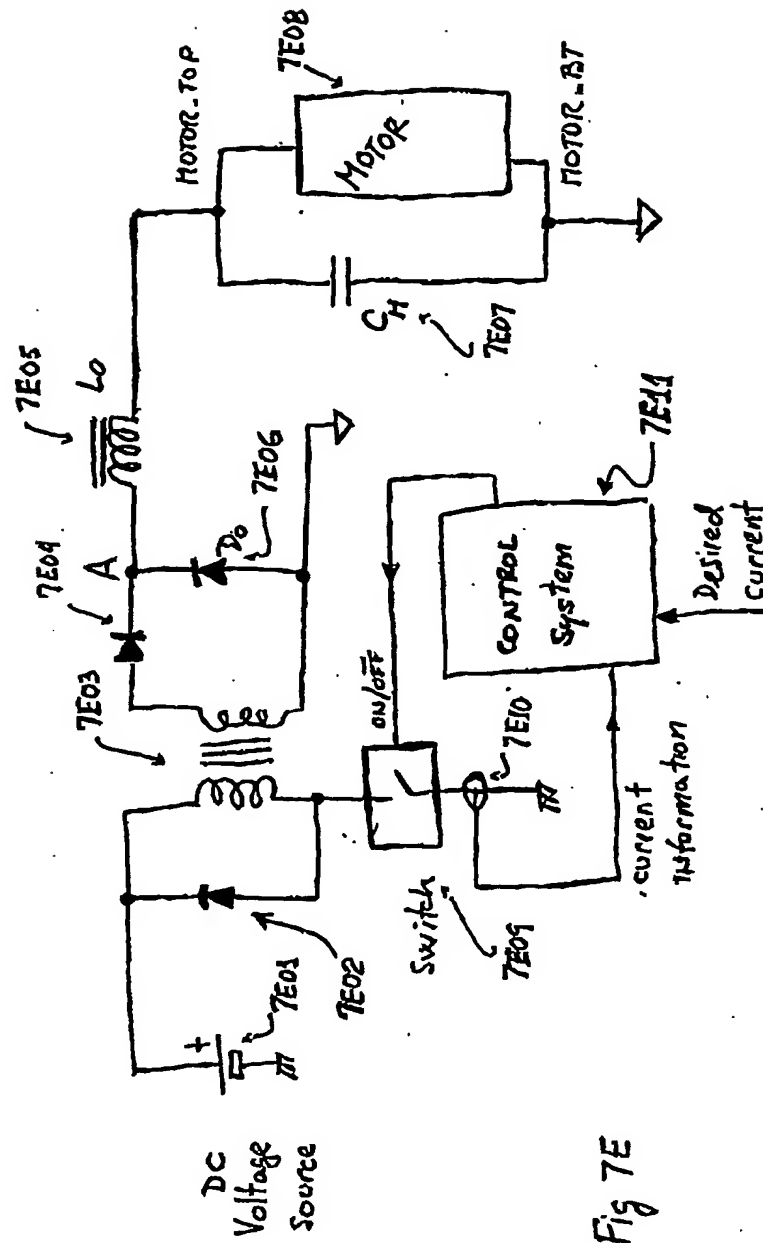
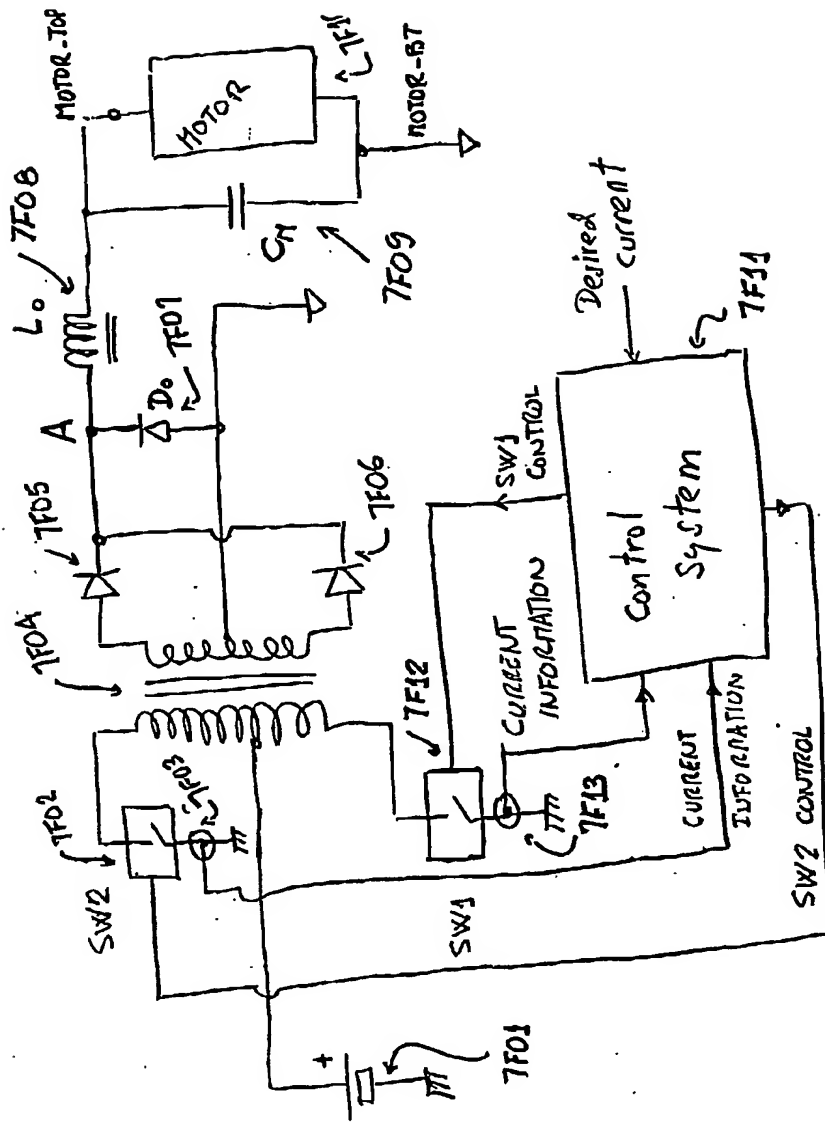


Fig 7D





DC  
Voltage  
Source

Fig 7F



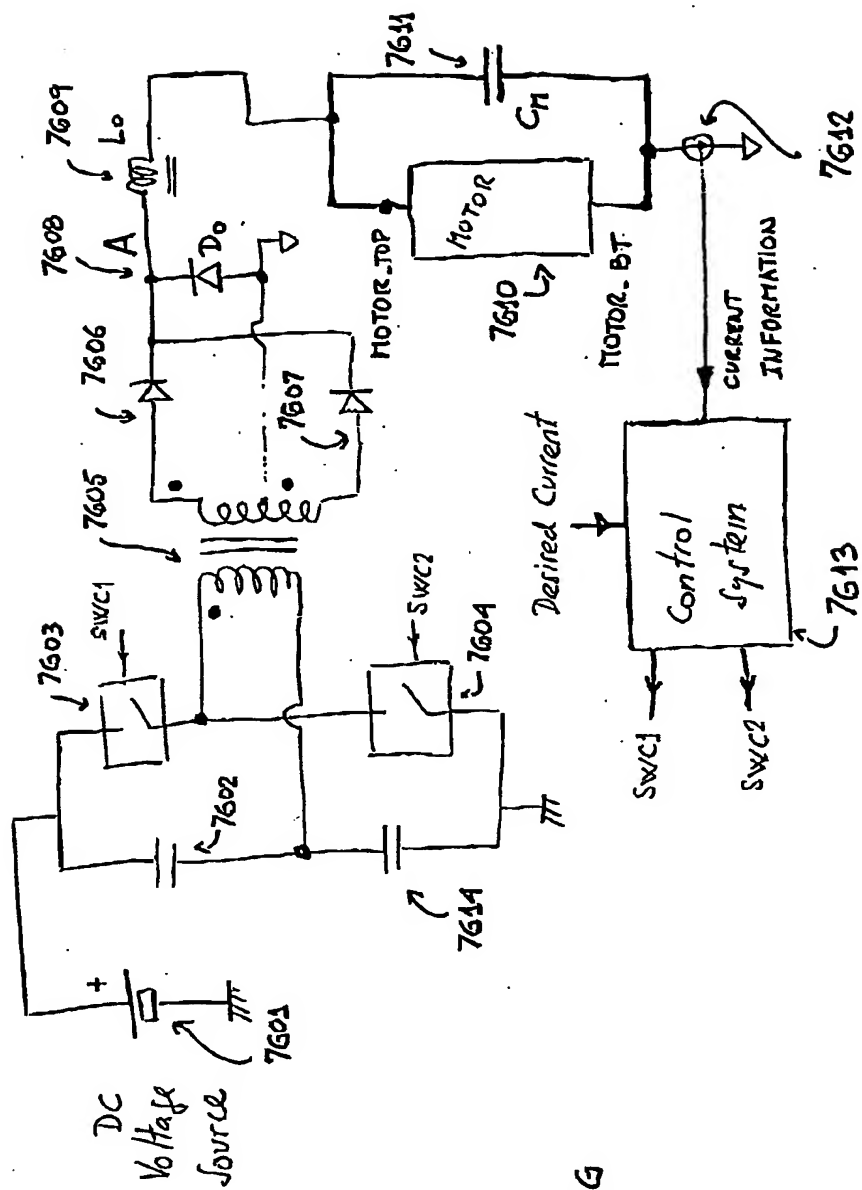
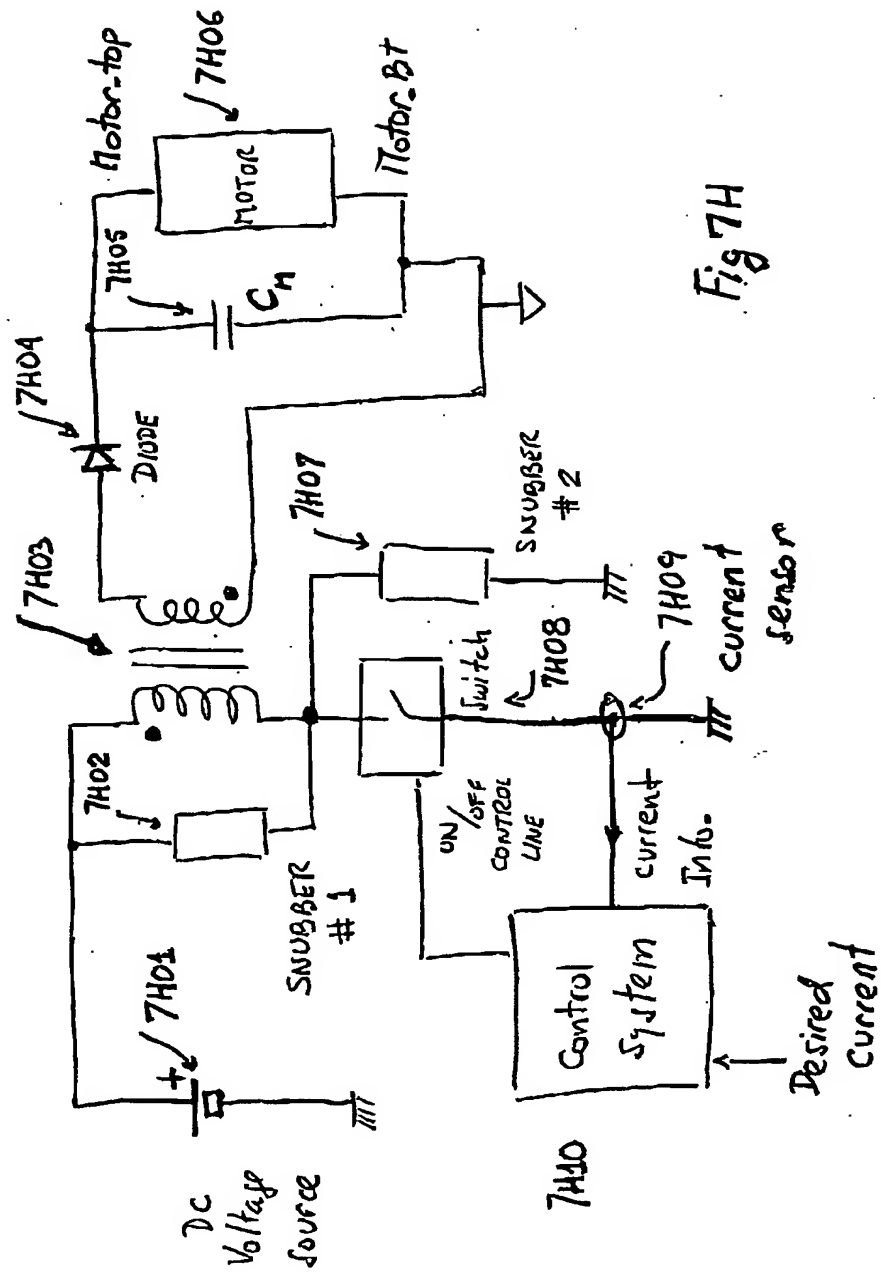


Fig 7G



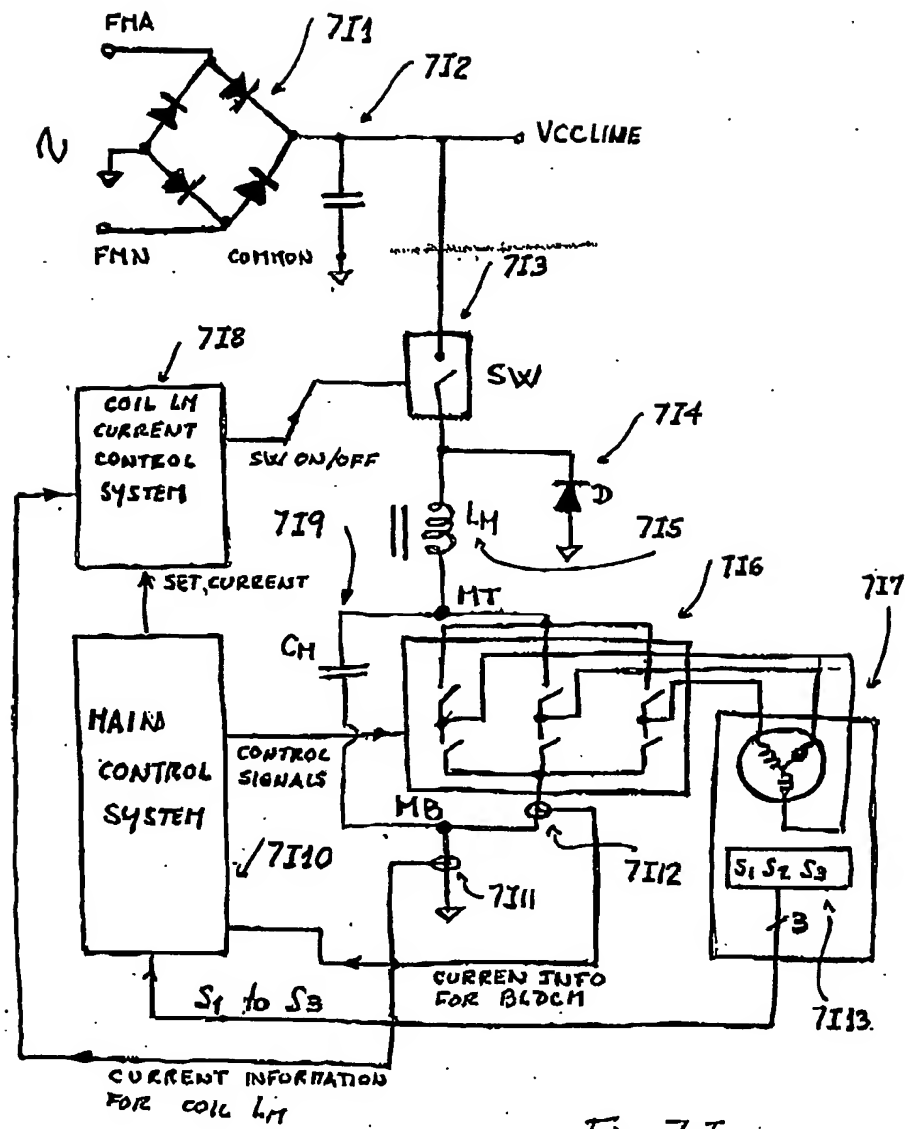
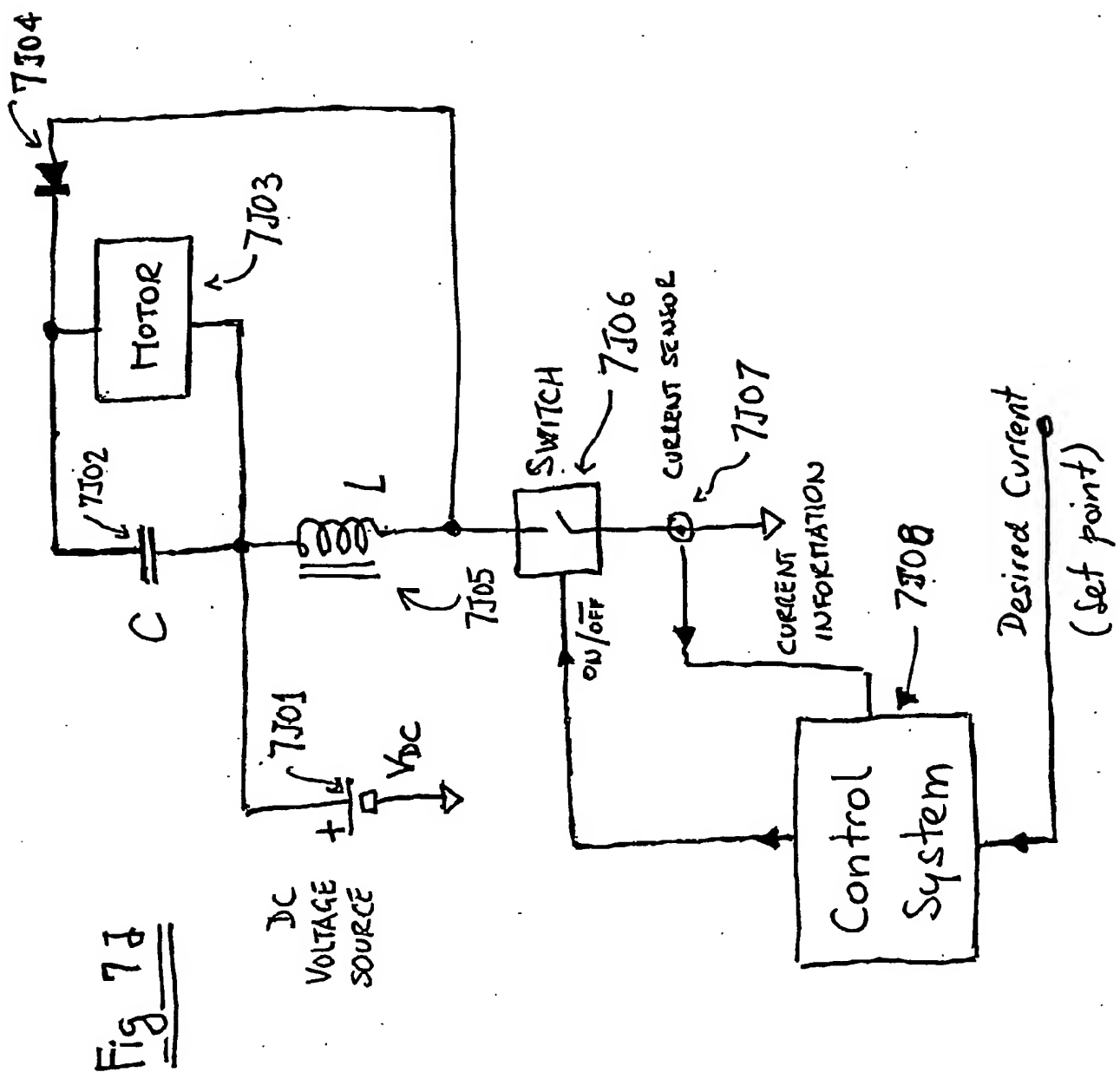


Fig 7I



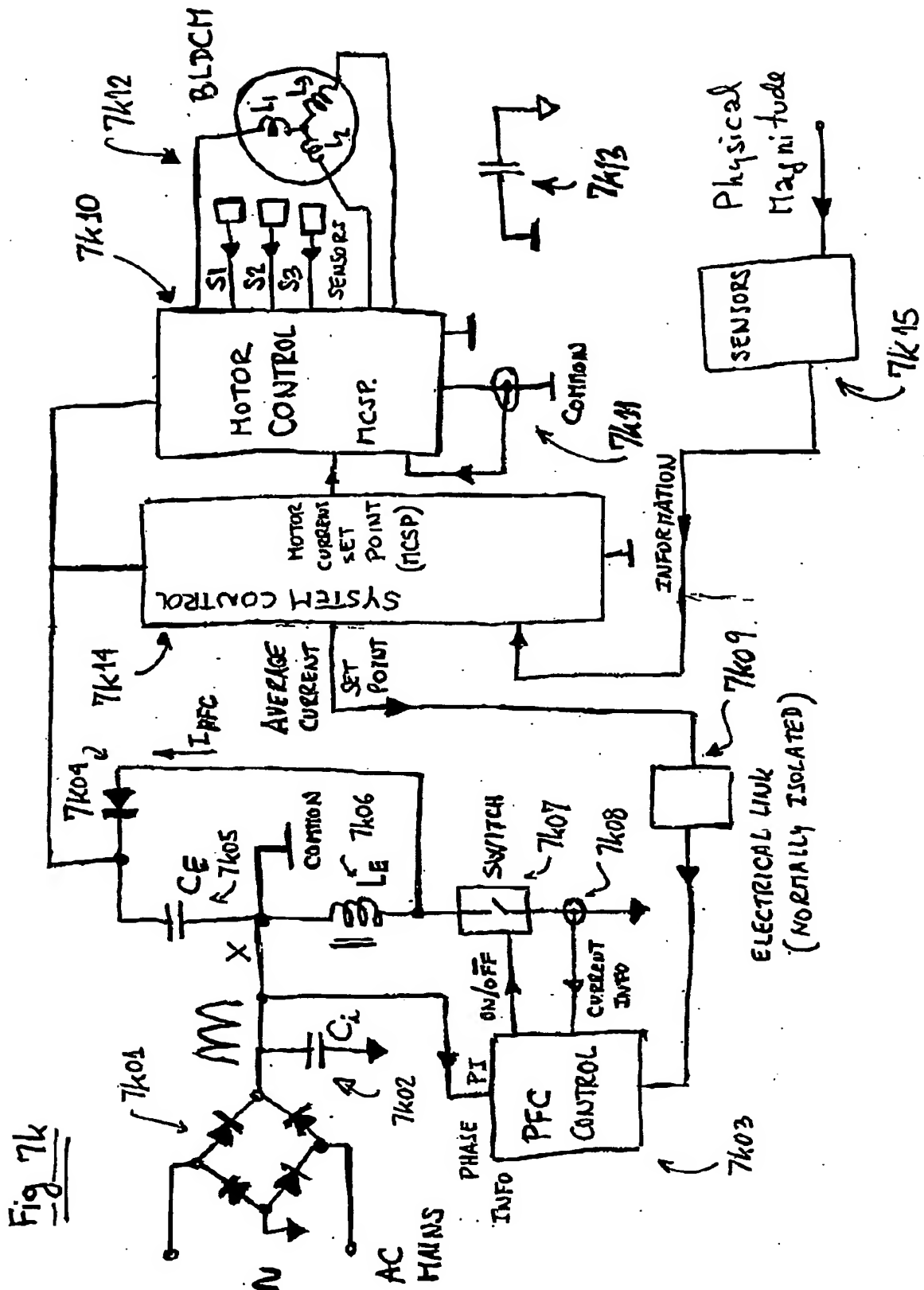
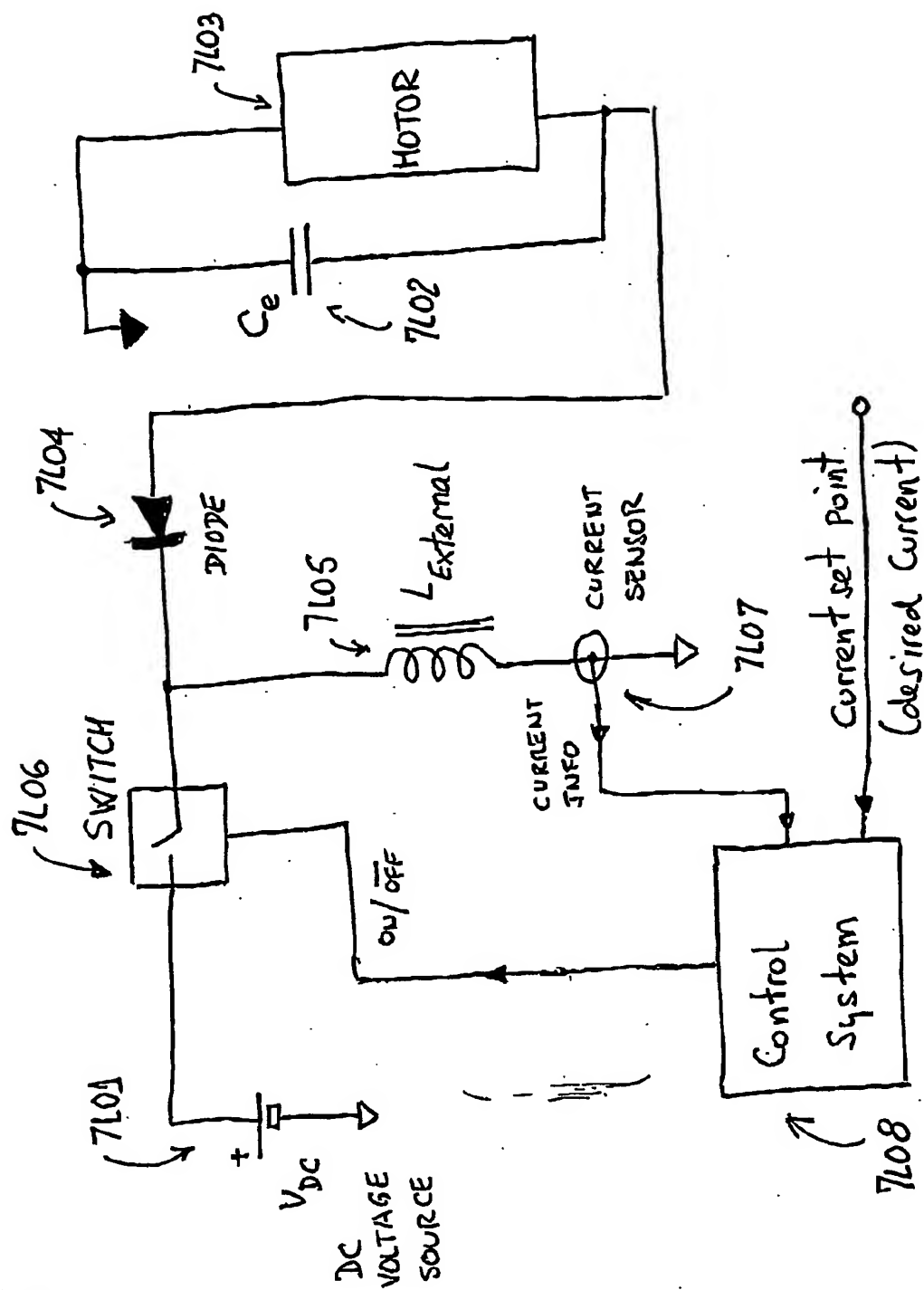


Fig 7L

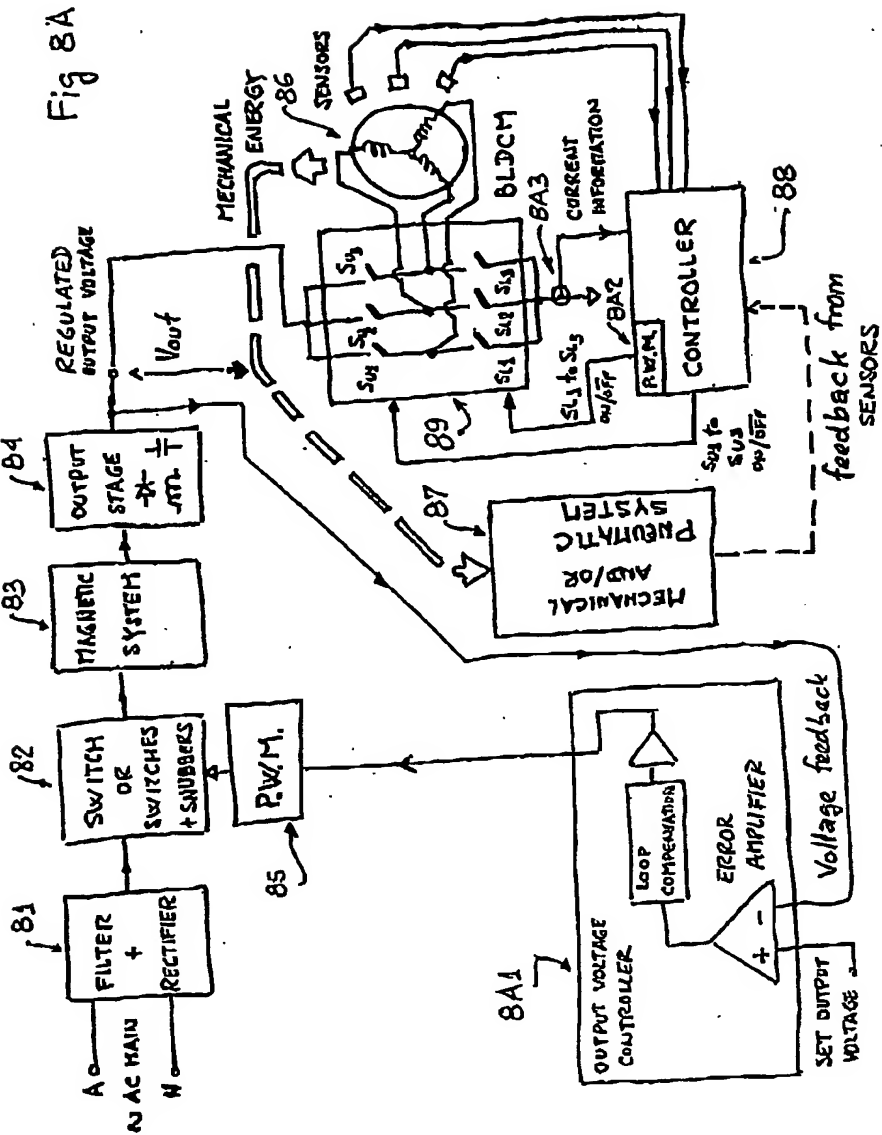
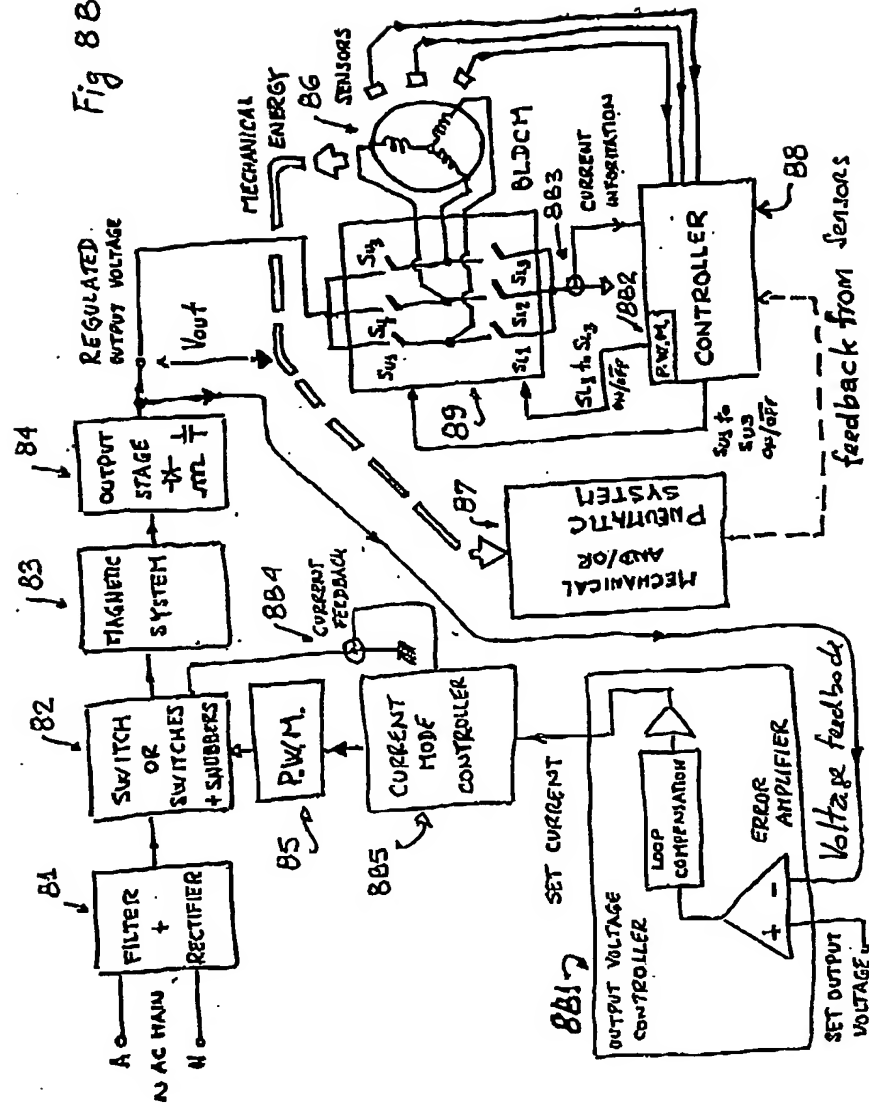
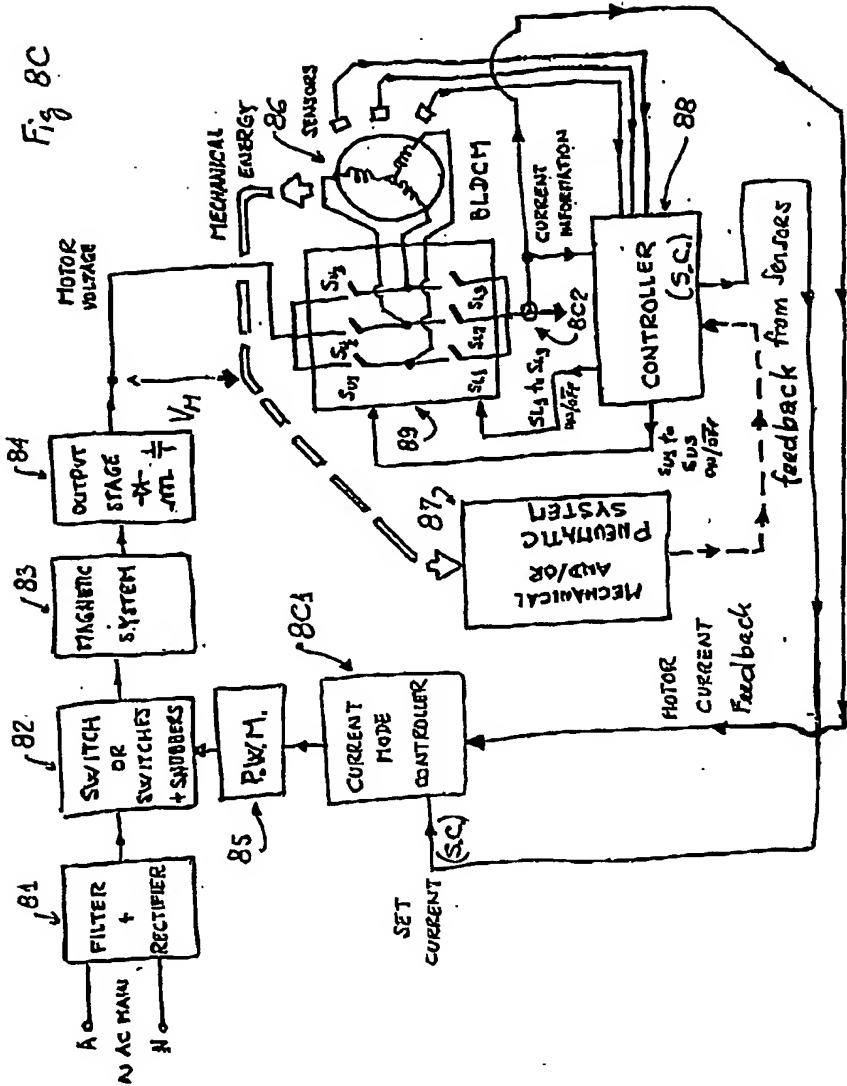
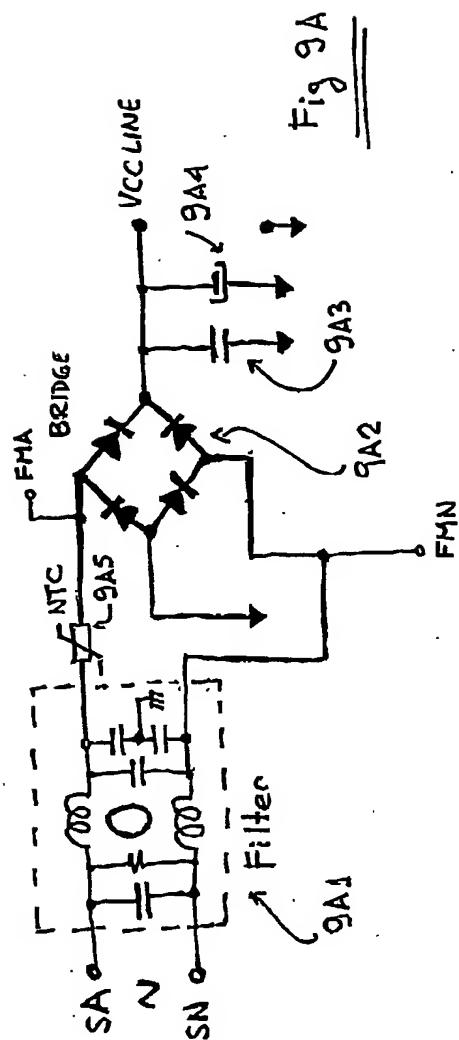


Fig 8B









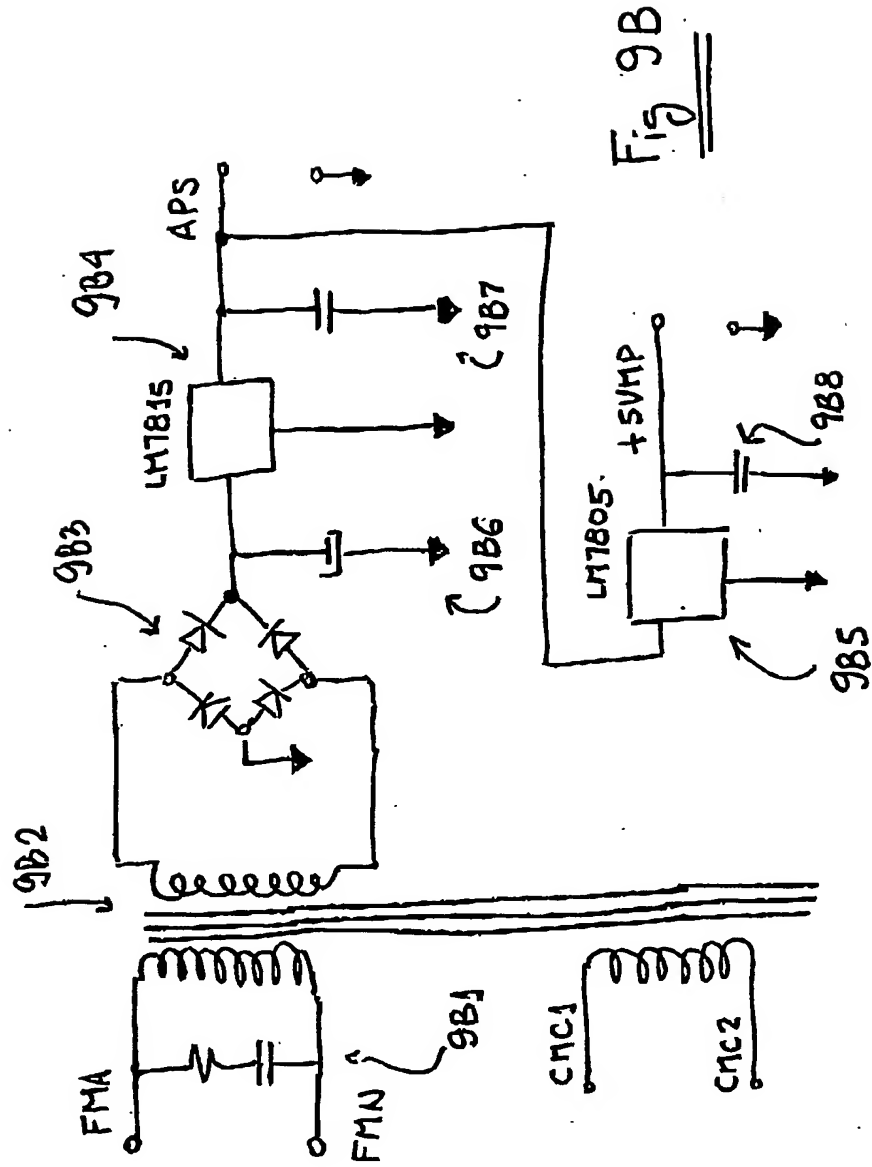
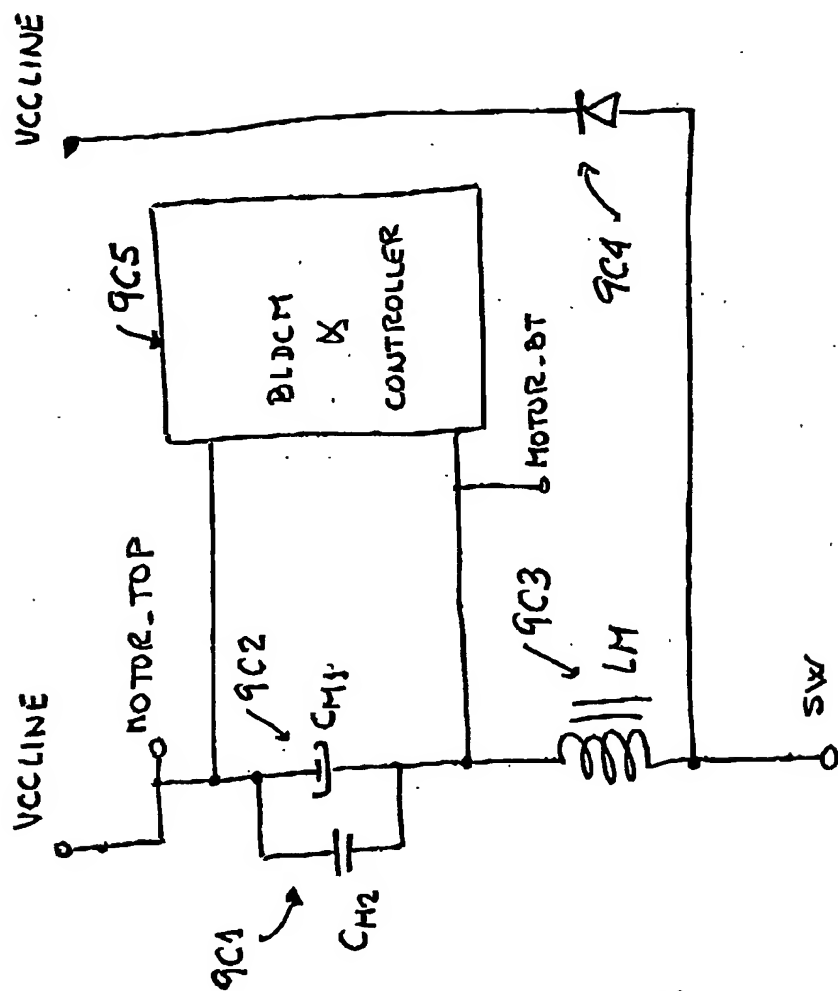


Fig 9B

Fig 9C

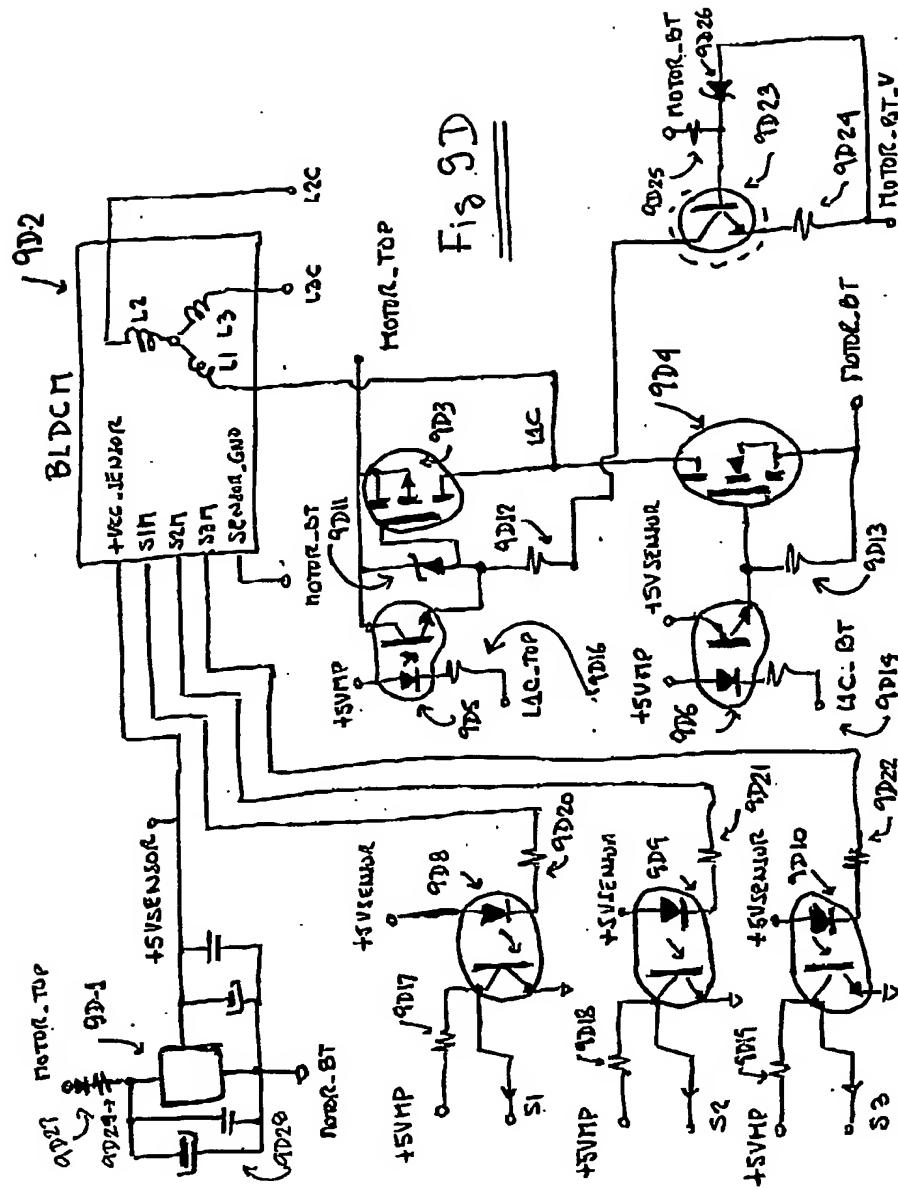
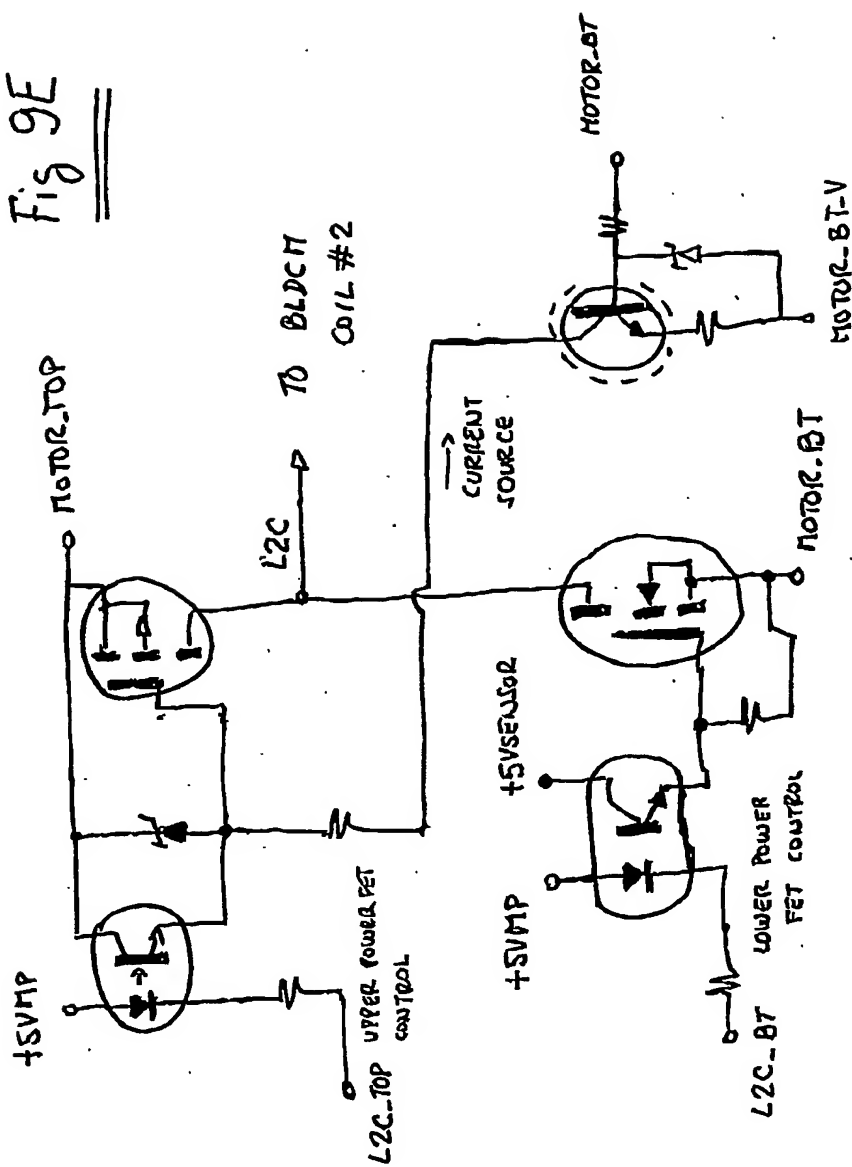
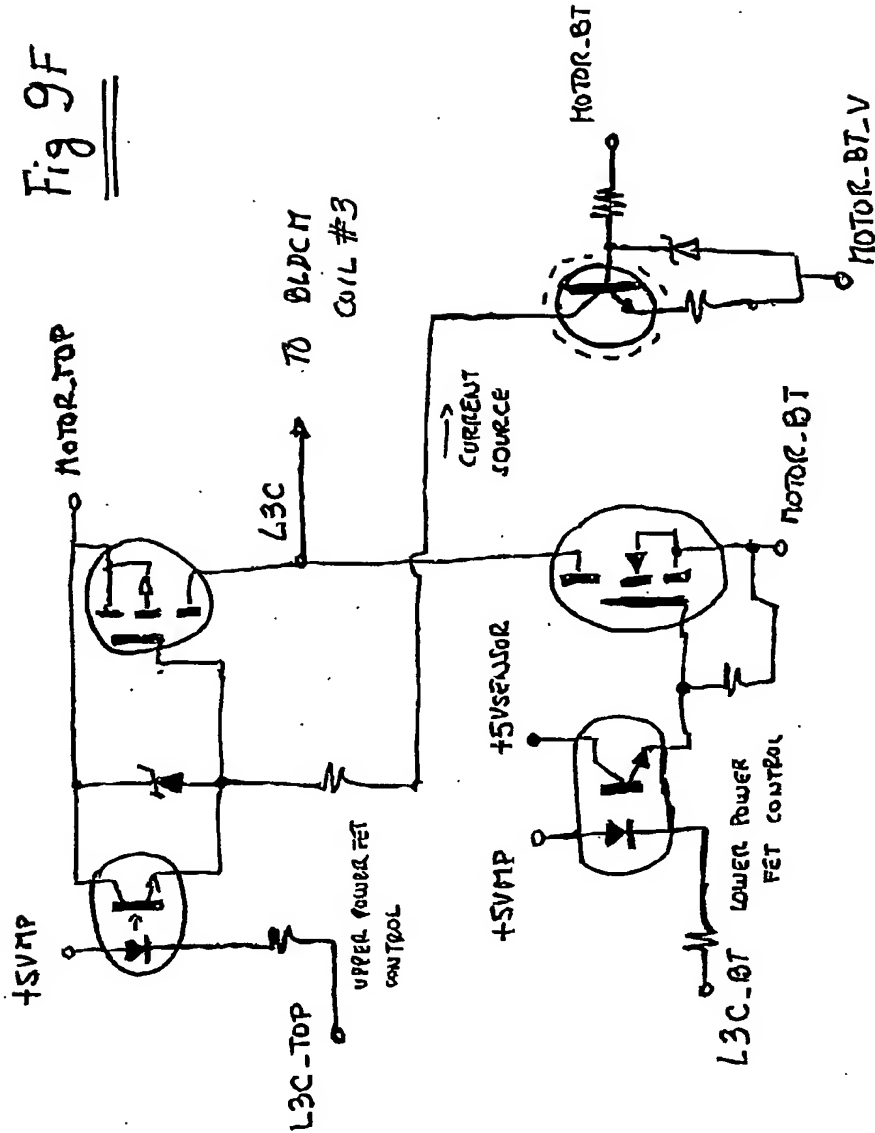
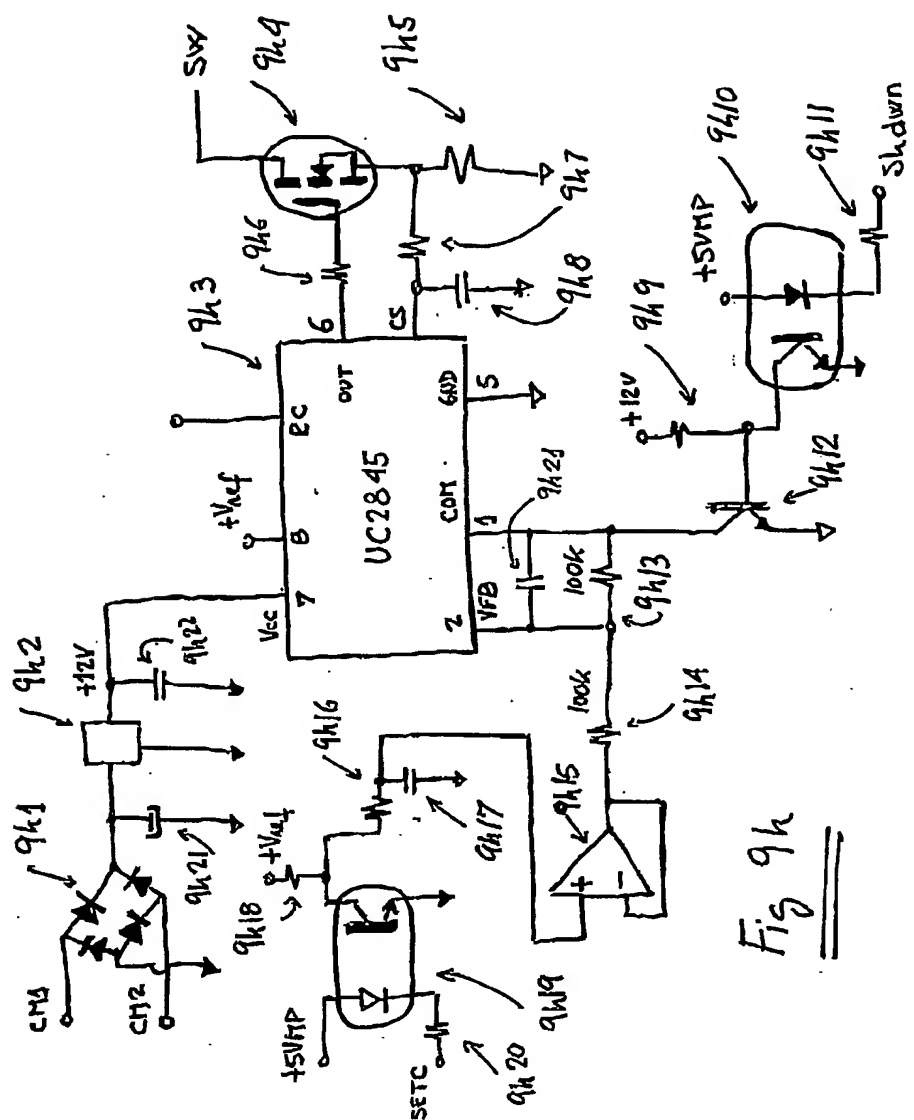


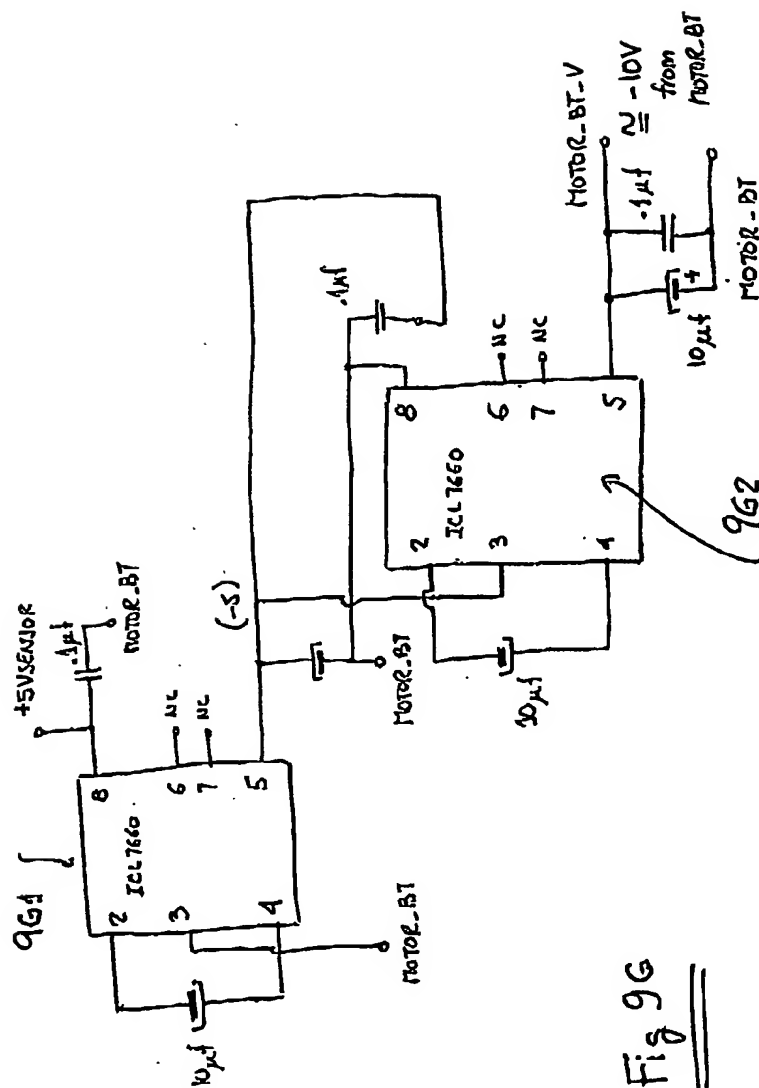
Fig 9E

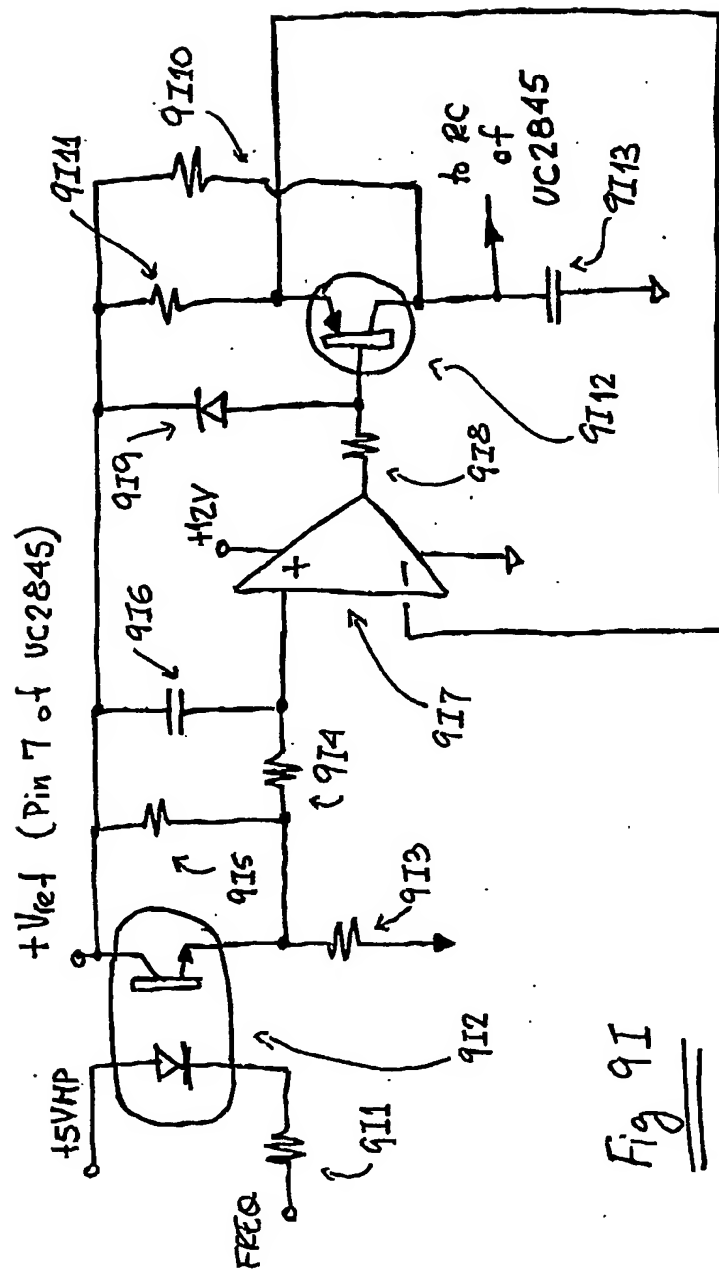


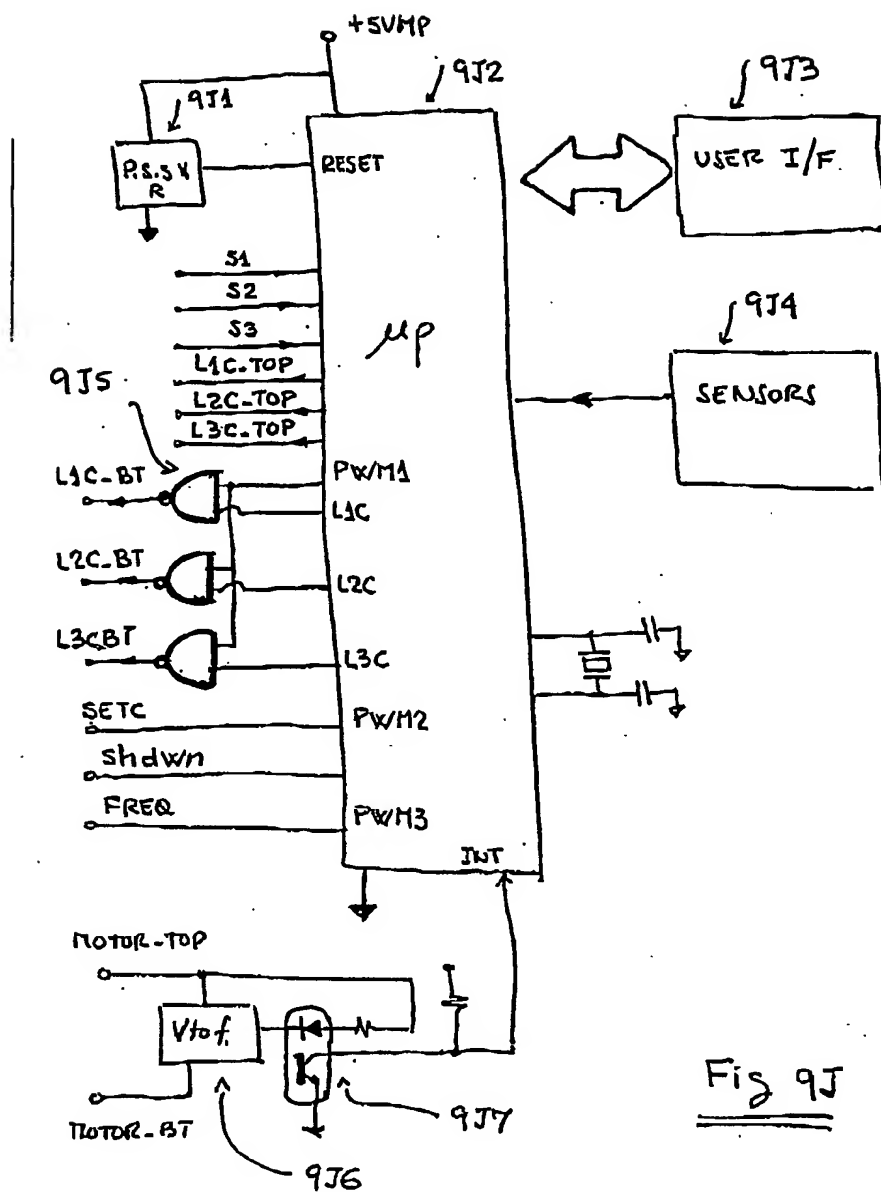


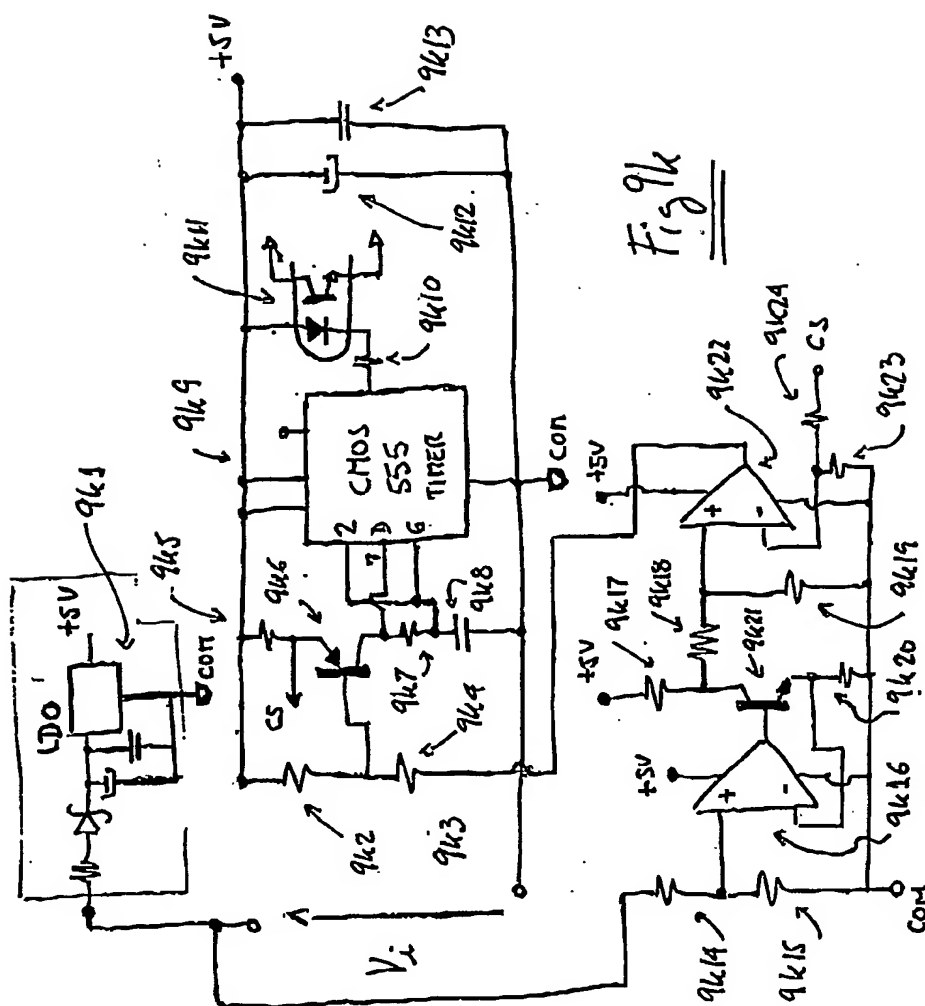
Fig 9k

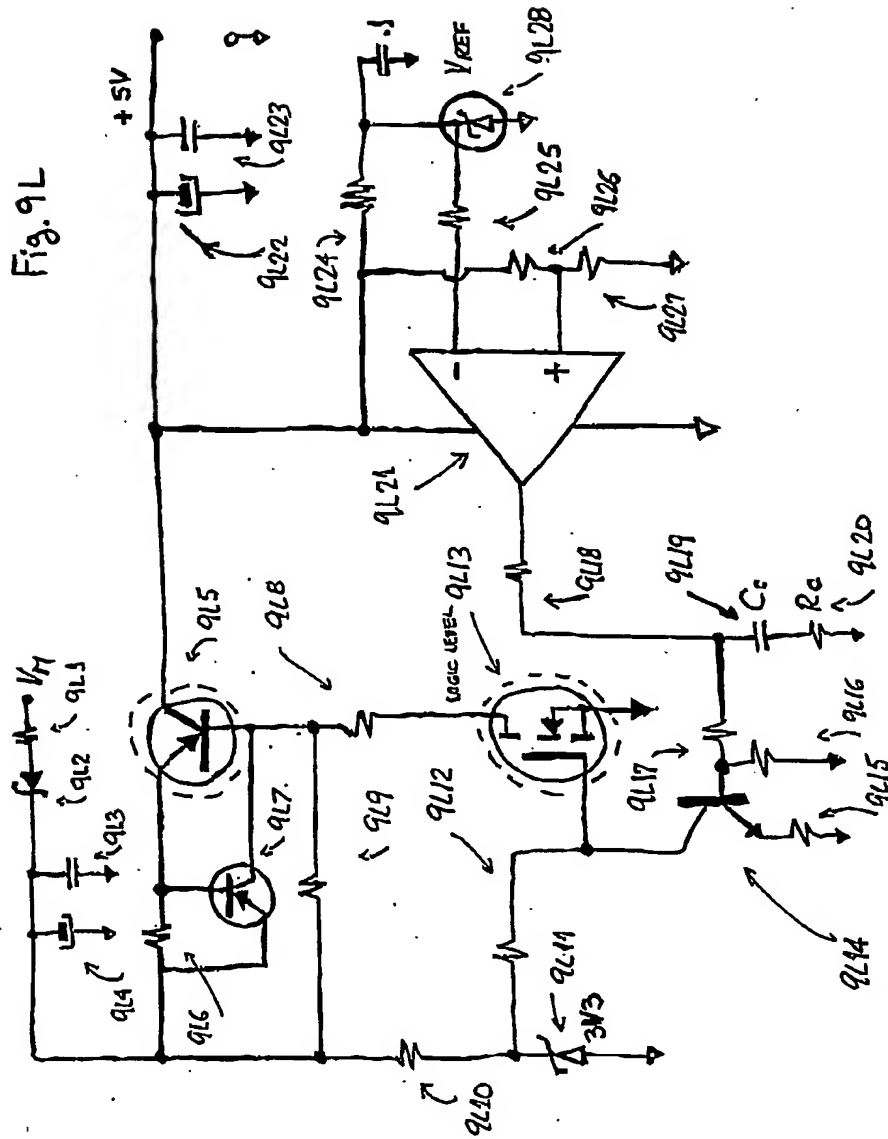


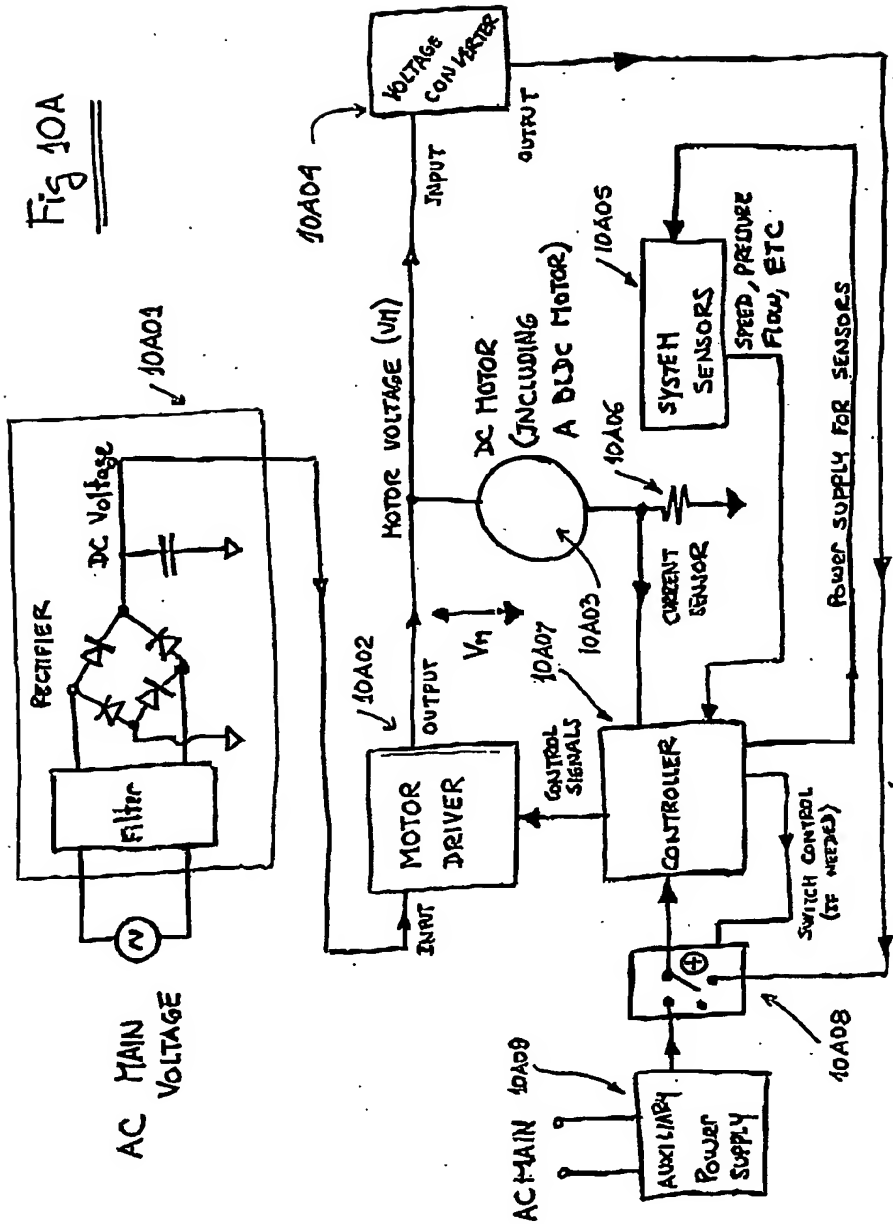
Fig 9G

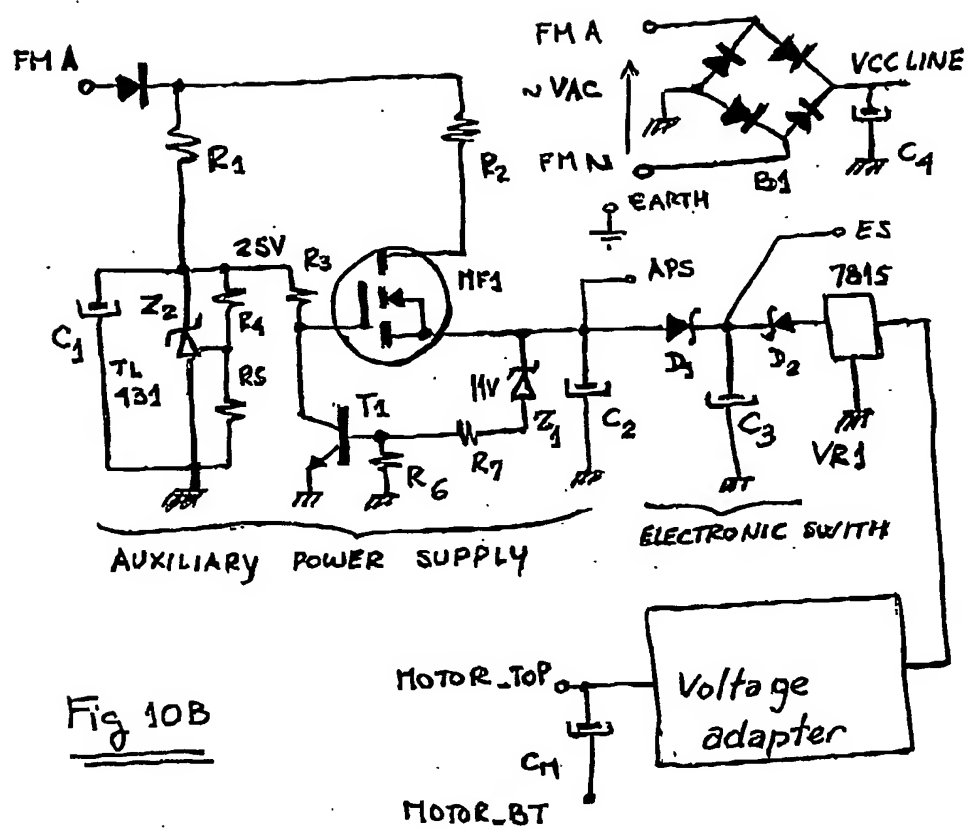


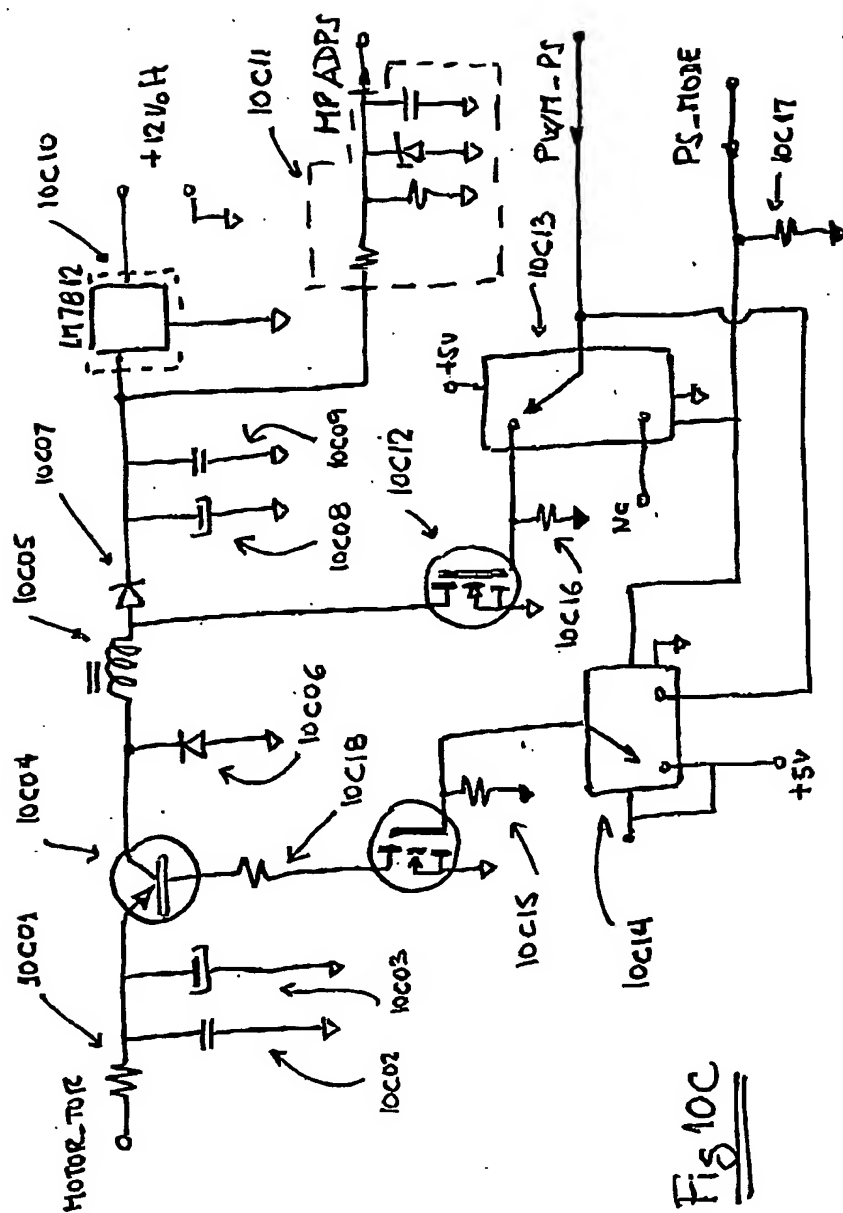




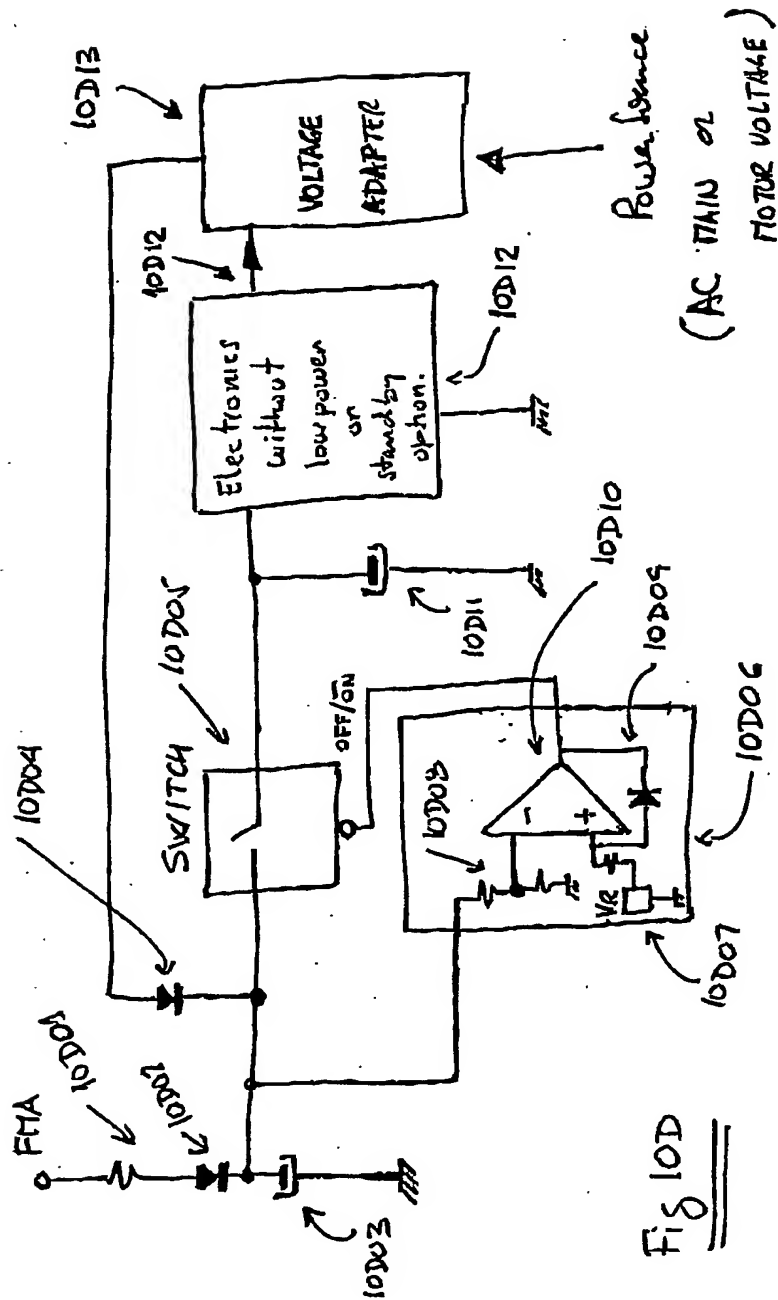


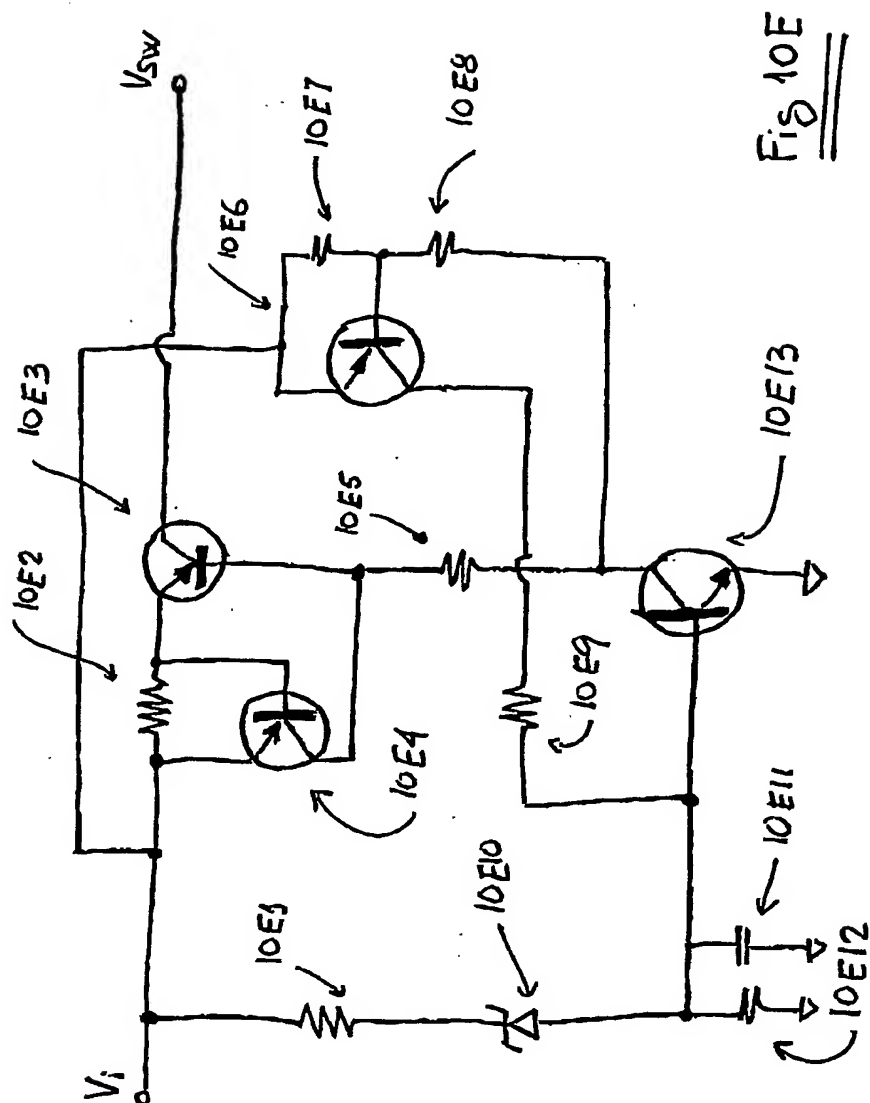


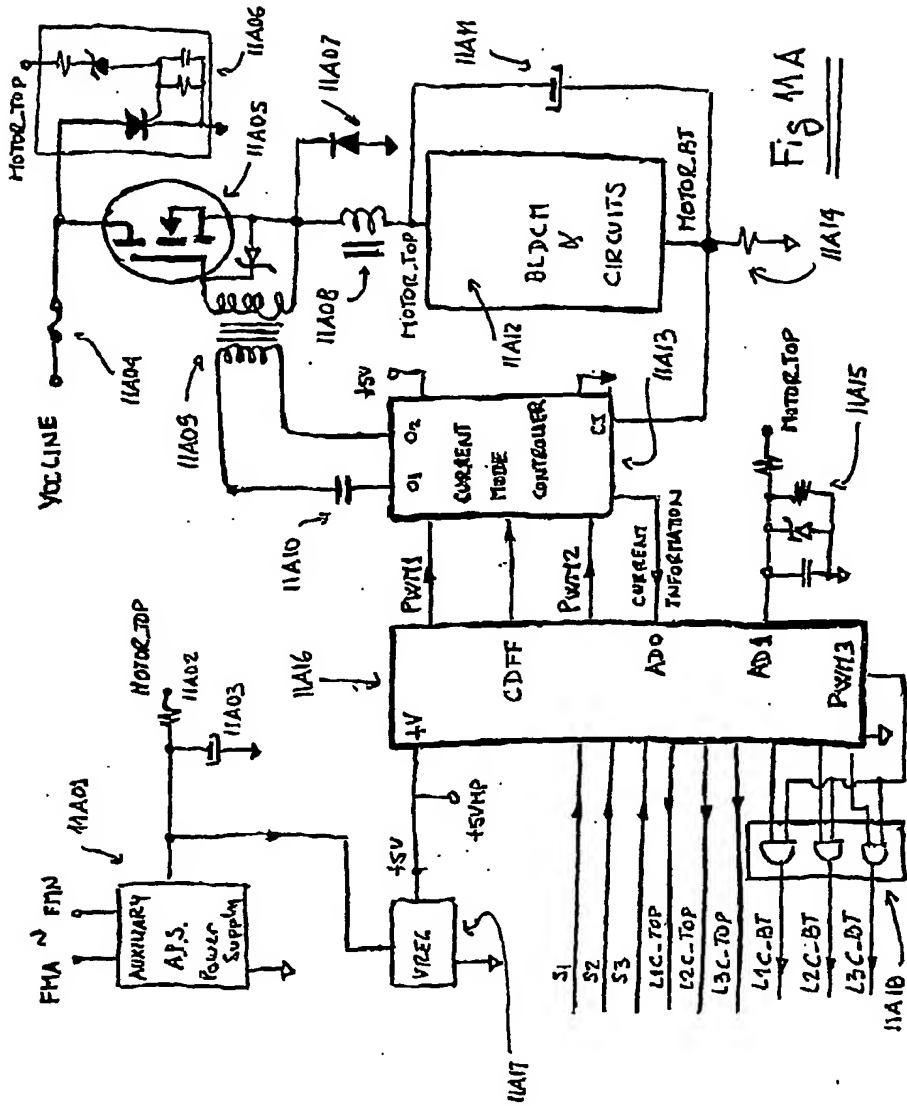


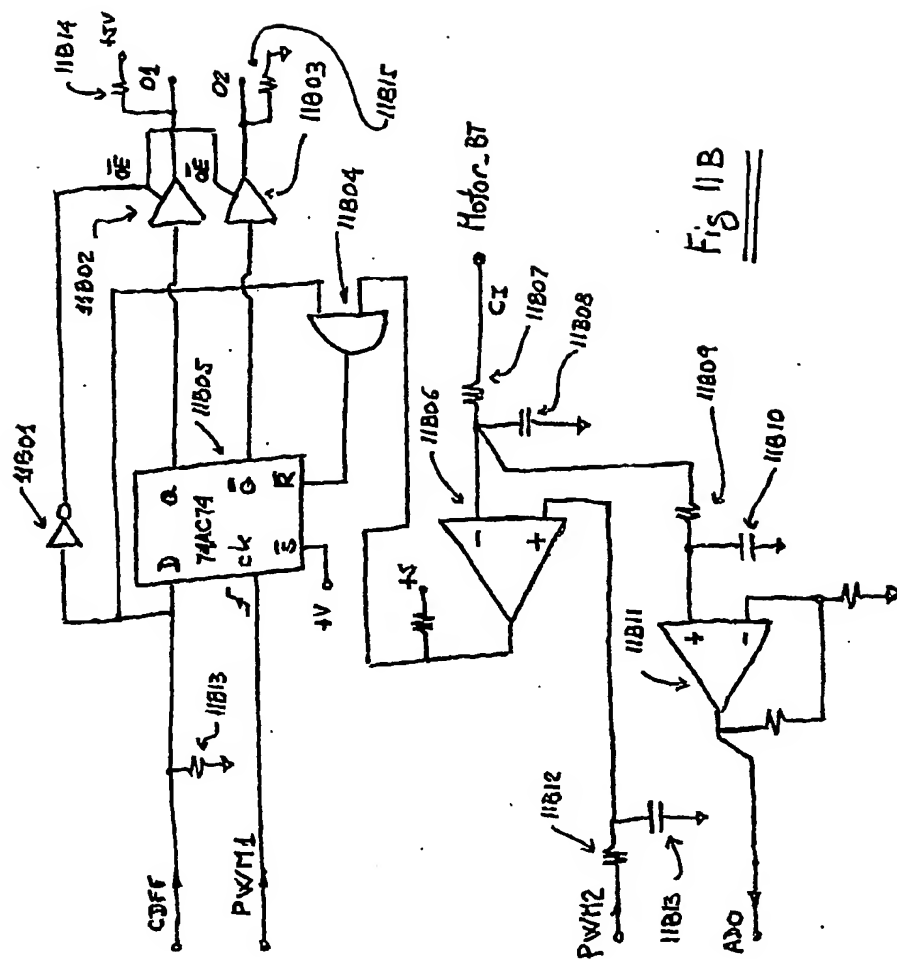












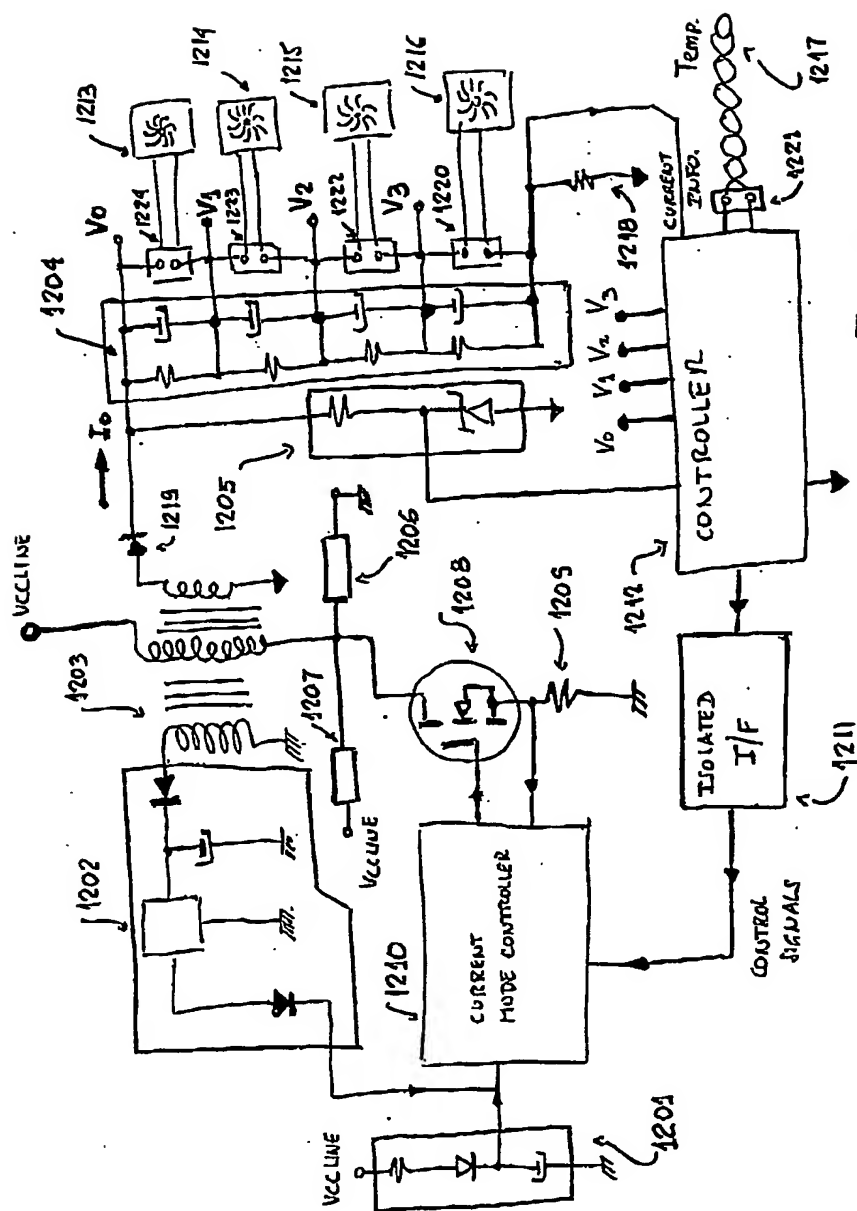
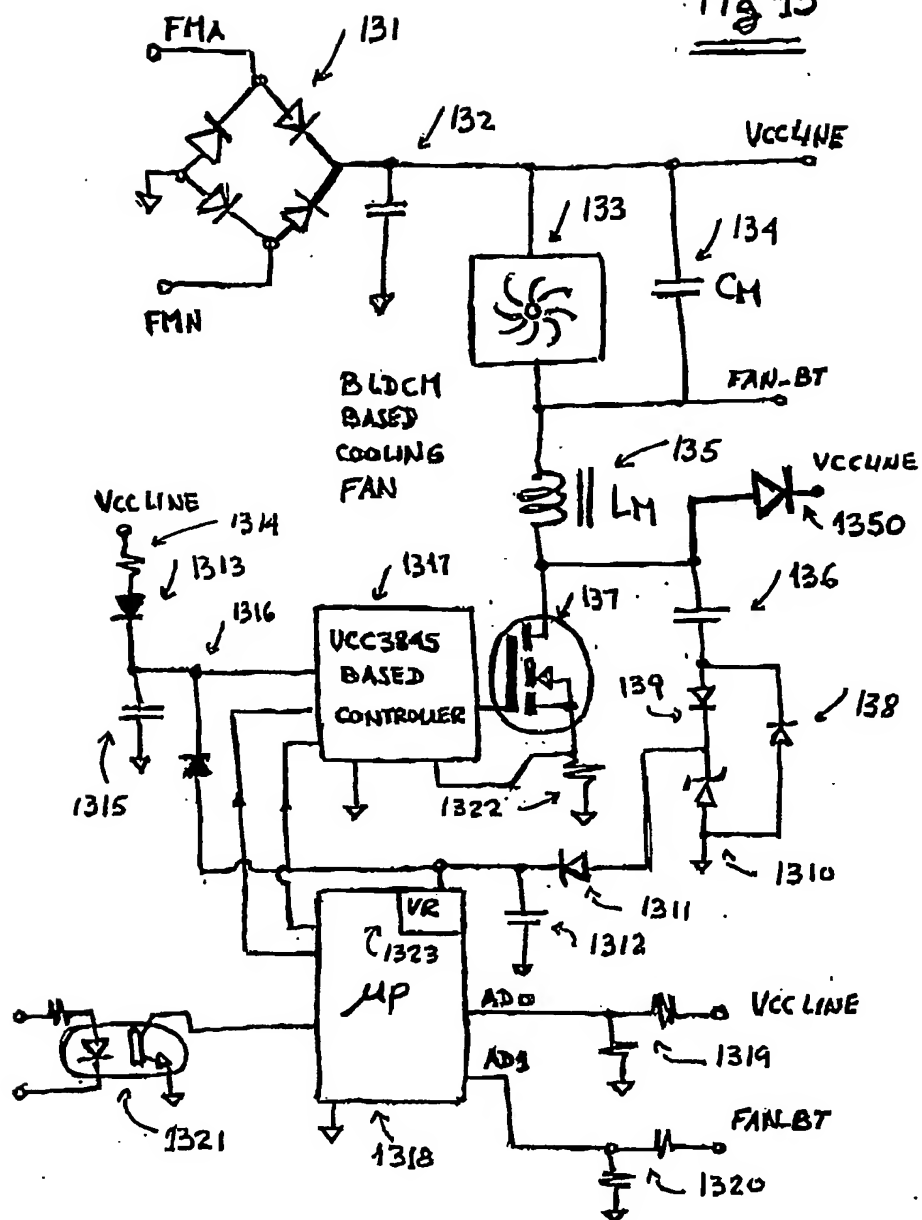


Fig 12

Fig 13

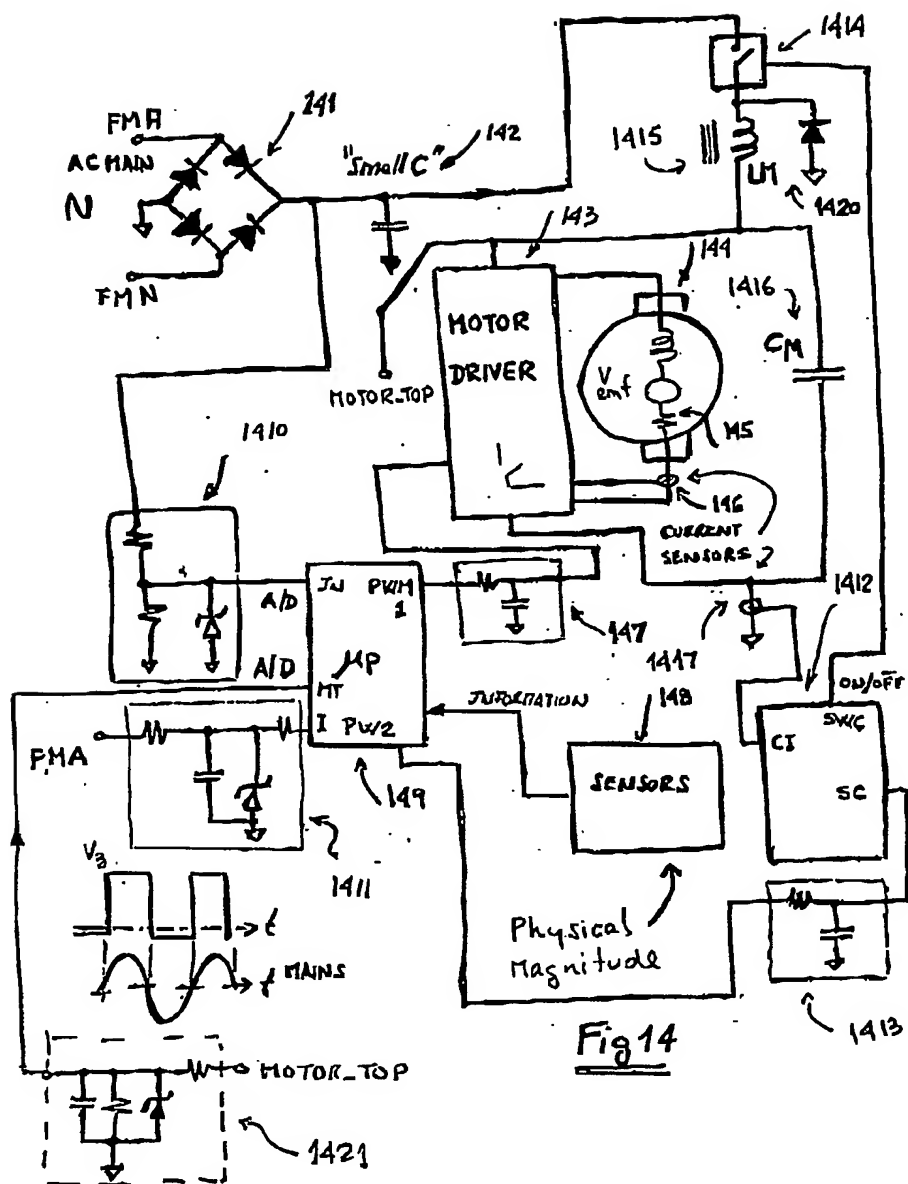
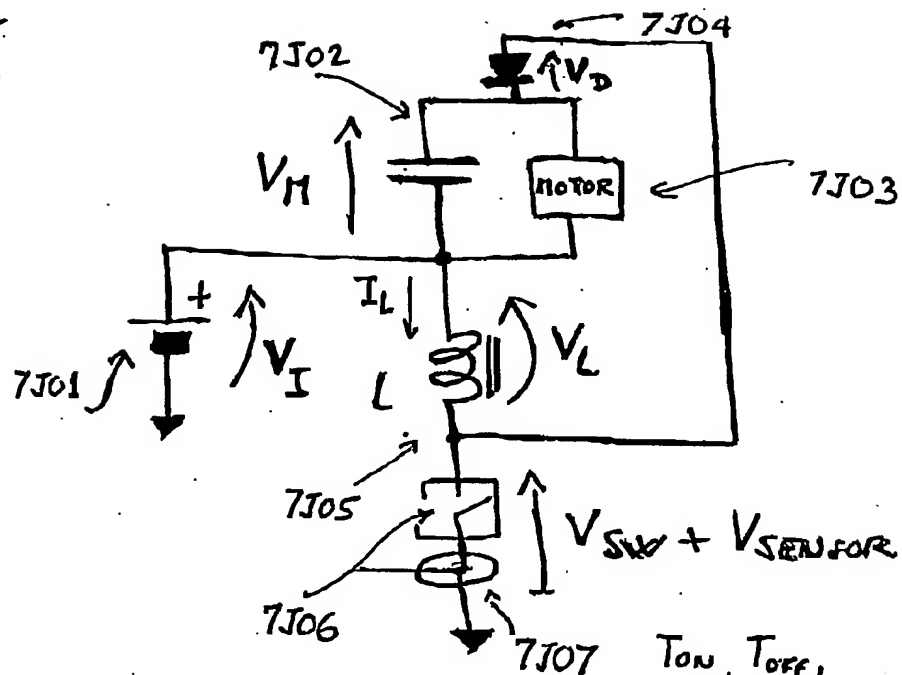
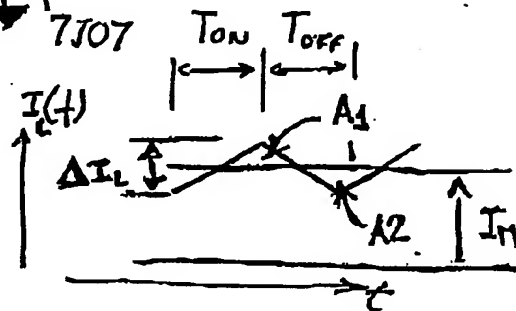


Fig 14

Fig 15

$$(1501) \quad V_M \cong I_M R_M + V_{emf}$$

$$(1502) \quad V_{emf} = k_v \omega_M$$



$$\begin{cases} V_{SW} + V_{SENSOR} \ll V_L & (1503) \\ V_D \ll V_M & (1504) \end{cases}$$

$$\Rightarrow \Delta I_L = \frac{V_I}{L_M} T_{ON} = \frac{V_M}{L_M} T_{OFF} \quad (1505)$$

$$(1506) \quad \frac{T_{ON}}{T_{OFF}} = \frac{V_M}{V_I} \quad (\text{For continuous conduction mode})$$



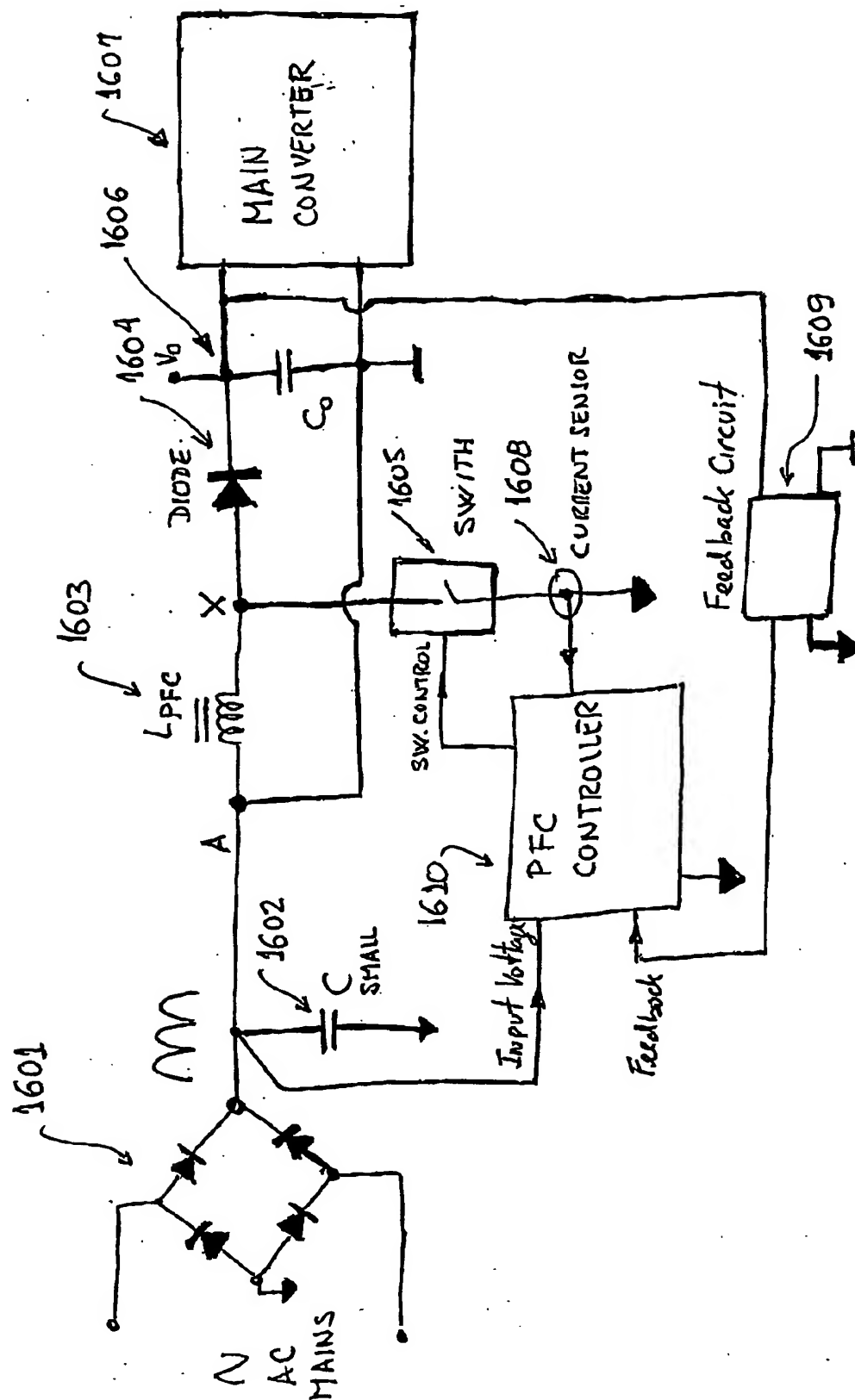
Fig 16

Fig 17A

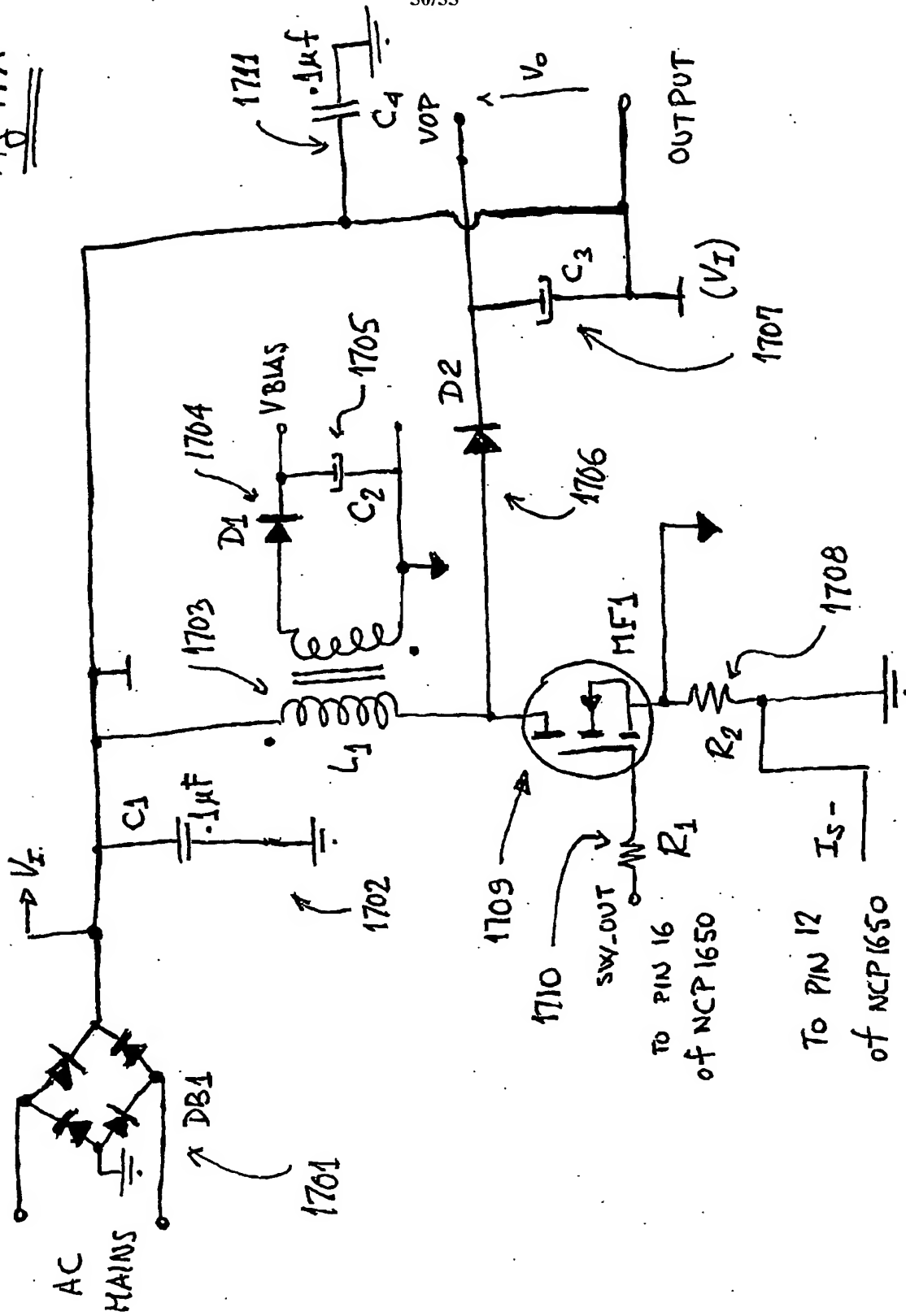


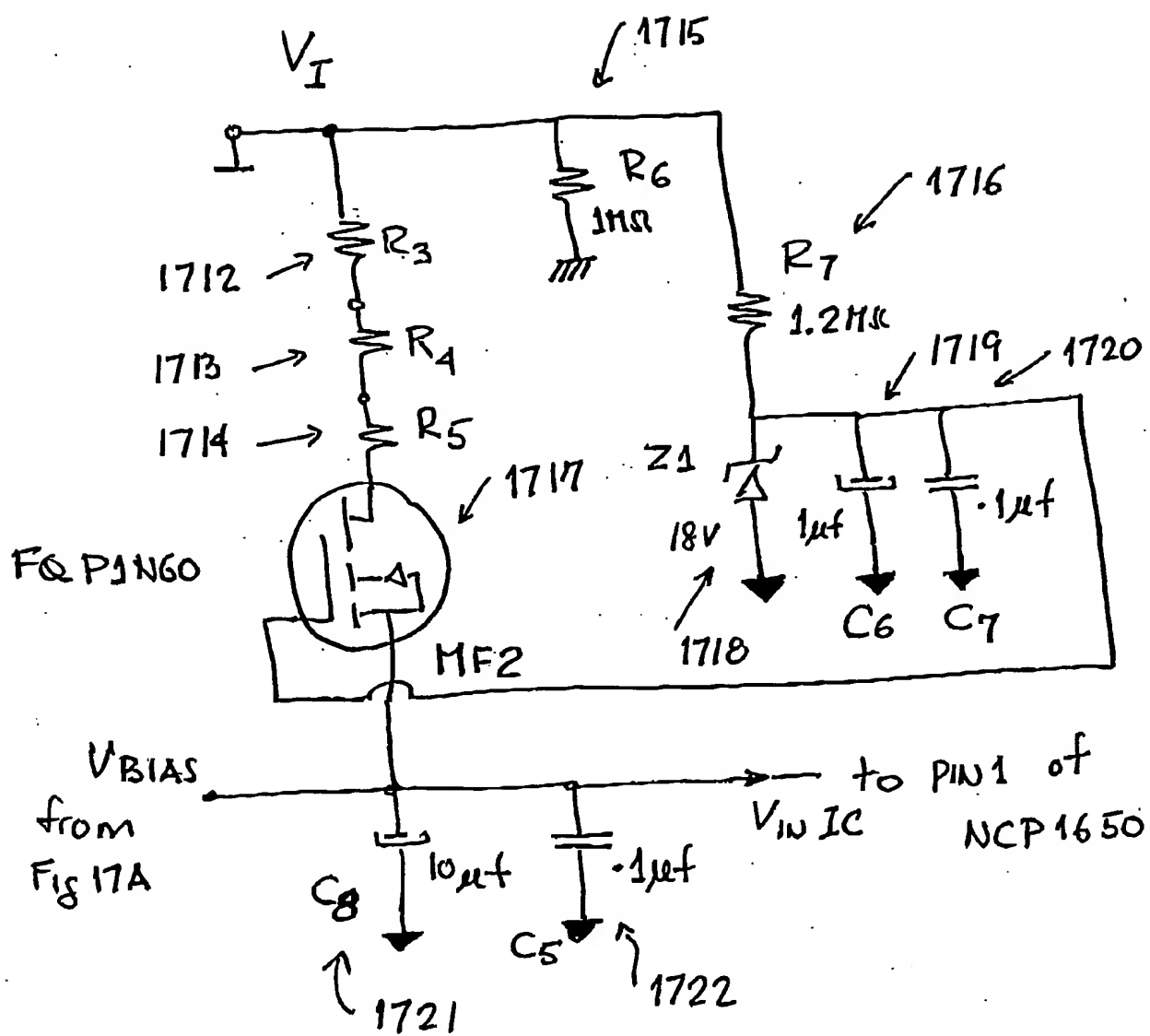
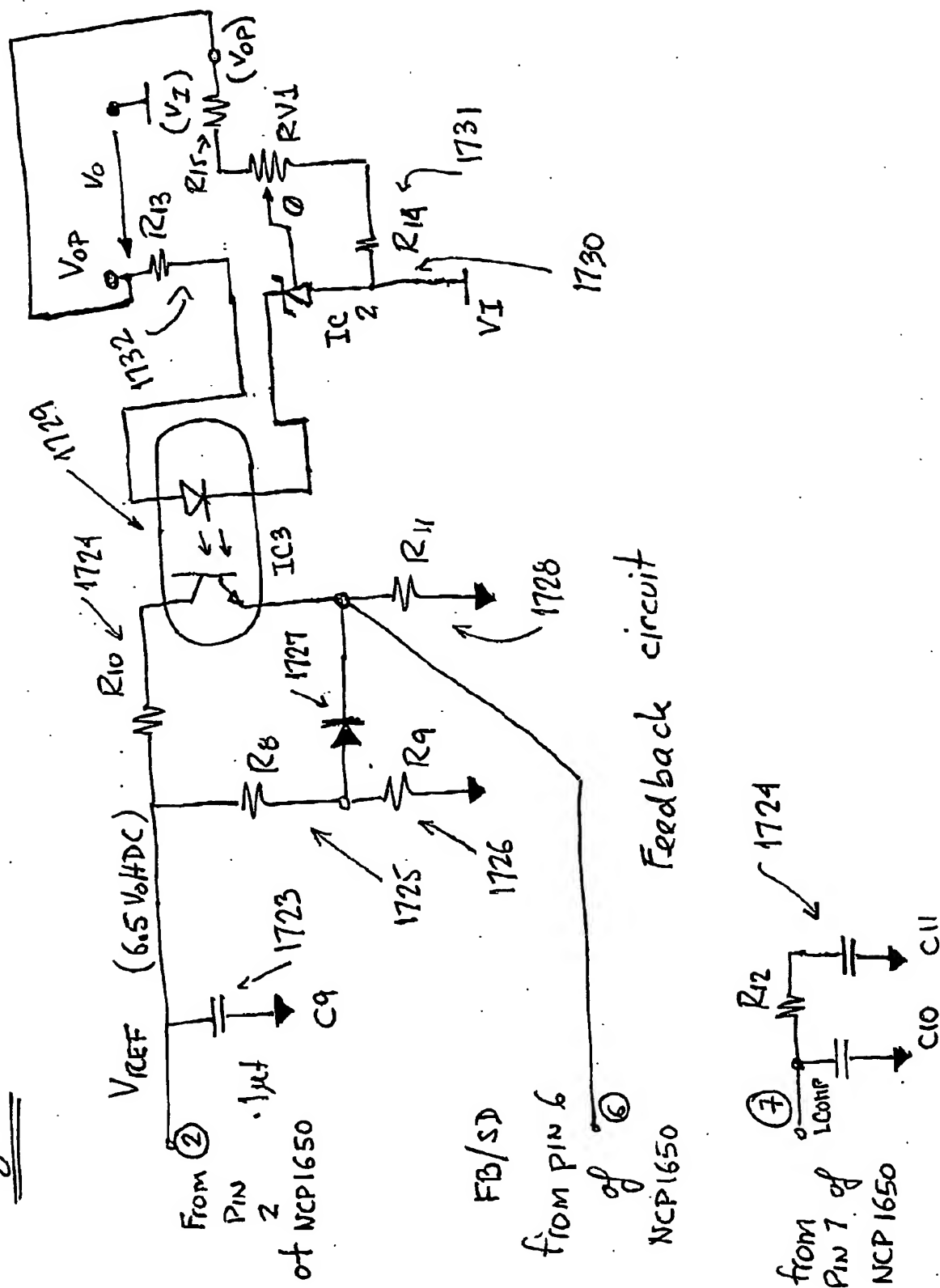
Fig 17B

Fig 17C



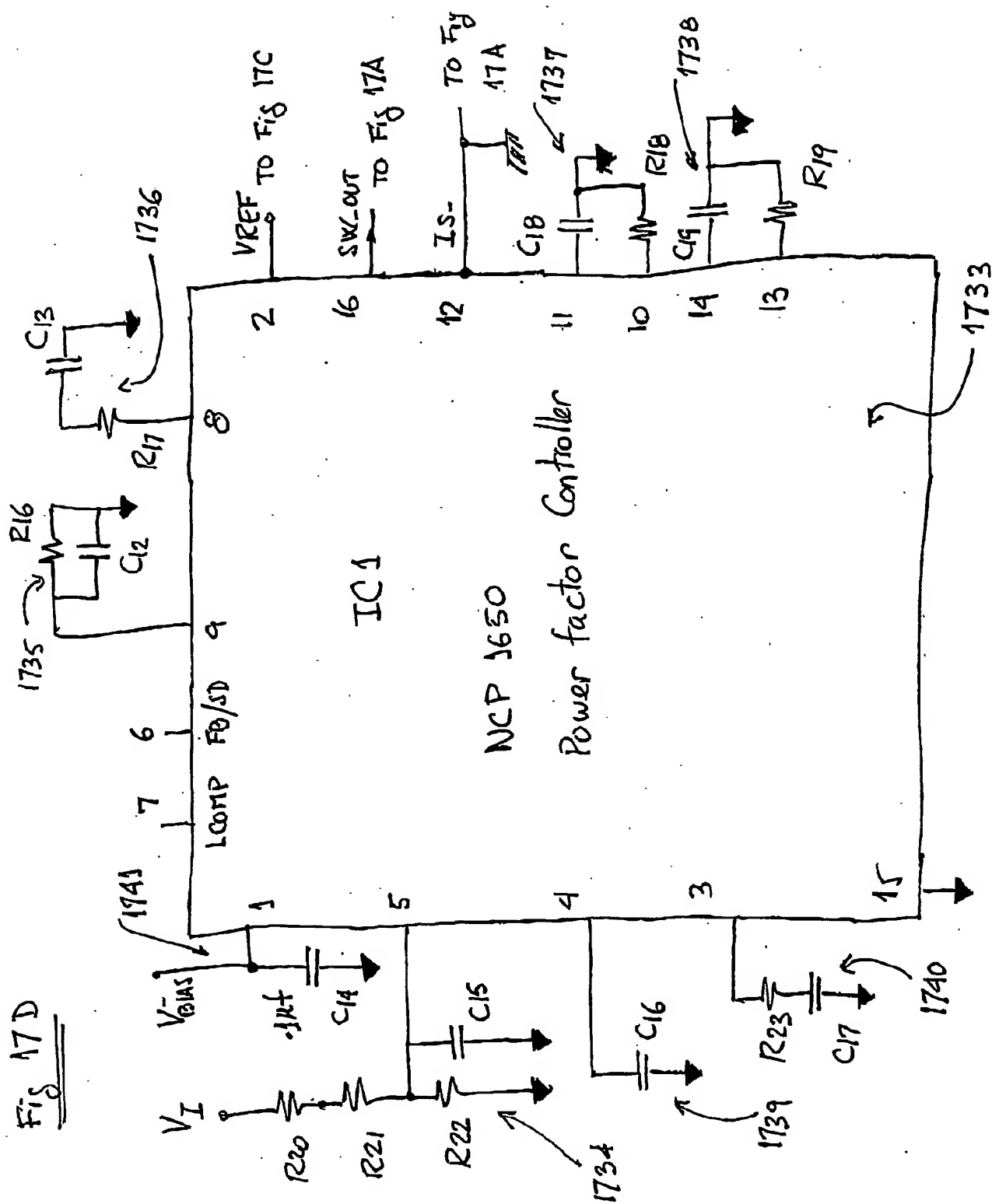


Fig 17E

